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### (54) **Surgical apparatus for marking tissue location**

Chirurgisches Instrument zur Markierung der Position eines Gewebes

Appareil chirurgical pour le marquage de la position d'un tissu

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**Description****BACKGROUND****1. Technical Field**

**[0001]** The present disclosure relates generally to tissue marking apparatus and method for identifying a particular location within a mass of body tissue.

**2. Background of Related Art**

**[0002]** Marking specific locations within body tissue, such as non-palpable lesions discovered within the body, and devices such as needles and wires for marking these lesions, are well known in the art. Such devices generally comprise a hypodermic needle or cannula which is inserted into the body and positioned adjacent to or in contact with the lesion. A wire marker is then passed through the needle or cannula and is anchored to the lesion marking it for subsequent surgical procedure, for example, excision or biopsy. Once the lesion is marked, the cannula is usually removed from the body, leaving the wire in place protruding from the body.

**[0003]** One of the most common procedures in which suspect tissue is marked is to locate potentially cancerous lesions found within a female patient's breast tissue. In such procedures, the subject breast is typically compressed during a mammographic tagging procedure. With some of the known devices, after the tissue marker is in place and compression discontinued, it is possible that the marker may dislodge or migrate from the position set during the tagging procedure.

**[0004]** Various tissue marking systems have been proposed to aid in locating non-palpable lesions within the breast and to prevent inadvertent dislodgment and/or migration of the needle. One such system includes a cannula needle and a wire guide made of a shape memory characteristic material which assumes a J-hook configuration. Such a device may be found, for example, in U.S. Patent No. 5,011,473 to Gatturna which discloses a needle inserted into the breast and advanced to identify the location of a lesion. Gatturna discloses a wire which is advanced inwardly allowing a J-hooked end to engage body tissue and immobilize the needle.

**[0005]** Devices utilizing such J-hook systems, however, have been unable to solve the problem of preventing migration of the tissue marker. For example, in such devices, the tissue marker can be displaced if pressure is applied to the breast during transportation of the patient to the surgical suite or during preparation of the patient for surgery. Also, if the strength or resiliency of the wire is less than that required to penetrate the lesion, the hook may not reform, allowing the marker to migrate.

**[0006]** Another example of existing tissue marking devices, referred to as a needle and hook-wire system, may be found in U.S. Patent No. 5,158,084 to Ghiatas. Ghiatas discloses a tissue-marking needle system

which includes a stainless steel wire having a hairpin hooked-end. Similar to the J-hook system, the needle is inserted into the breast tissue to locate the lesion and the wire is slid through the needle thereby engaging the body tissue and anchoring the wire at lesion's location.

**[0007]** A further example of existing tissue marking devices is disclosed in WO 92/12678 which comprises a localization needle assembly including an outer tubular cannula and a reinforced needle. The needle comprises a rearwardly extending retractable barb which is deployed through an opening in the sidewall of the outer cannula for anchoring the needle in body tissue in the proximity of the lesion.

**[0008]** In such devices, however, compression of the breast, e.g., as routinely done during mammographic filming of the breast, may result in migration or displacement of the needle. Although the hook will tend to prevent outward movement of the wire, it is not designed to prevent advancement of the wire further into the patient's breast tissue.

**[0009]** Accordingly, a need exists for an improved tissue marking apparatus which overcomes the above-noted limitations of existing tissue marking devices, is easy to use and provides more reliability when marking suspect tissue. Such an improved tissue marking apparatus is disclosed in claim 1.

**SUMMARY**

**[0010]** The present disclosure provides a tissue marking apparatus and a method for marking a particular location in body tissue, which addresses the limitations associated with conventional tissue marking devices. Additionally, the present disclosure provides a tissue marking apparatus for marking a location within tissue which may be used in both minimally invasive as well as open surgical procedures.

**[0011]** One embodiment of the present disclosure provides a tissue marking apparatus for marking a location within tissue, such apparatus including (i) a needle including a housing and an elongated tube having a sharp distal end, (ii) an elongated cable configured and dimensioned to pass through a longitudinal passage-way formed through the needle, (iii) an elongated tissue marker attached adjacent a distal end of the elongated cable such that the elongated marker is movable between a retracted orientation and a deployed orientation, and (iv) an actuator assembly operatively associated with the elongated marker, wherein movement of the actuator assembly from a first position to a second position moves the elongated marker from the retracted position to the deployed position.

**[0012]** In a preferred embodiment, when the elongated marker is in the retracted position, a longitudinal axis of the elongated marker is substantially parallel to a longitudinal axis of the elongated cable. Additionally, when the elongated marker is in the deployed position, the longitudinal axis of the elongated marker is substantially

perpendicular or transverse to the longitudinal axis of the elongated cable.

[0013] In an alternative embodiment, the elongated marker is movable between (i) a retracted position, wherein the elongated marker forms a substantially uniform transverse dimension, and (ii) a deployed position, wherein the elongated marker has a transverse dimension which is substantially greater than that of the outer surface of the elongated needle tube. Preferably, in the retracted position, the elongated marker includes an outer surface which is in substantial alignment with the outer dimension of the elongated needle tube which is used to introduce the elongated marker to the target tissue.

[0014] Preferably, the actuator assembly includes a first deployment actuator operatively connected to the housing and a second deployment actuator operatively associated with the first deployment actuator. The actuator assembly also preferably includes an advancing tube disposed between the first deployment actuator and the elongated marker.

[0015] The present disclosure also provides a surgical apparatus for marking a particular location in body tissue, which includes (i) a needle defining a longitudinal passageway therethrough, (ii) an elongated cable configured and dimensioned to pass through the longitudinal passageway, (iii) an elongated marker attached adjacent a distal end of the elongated cable such that the elongated marker is movable between a retracted orientation and a deployed orientation, and (iv) a stabilizer member which is moved from a first position relative to the elongated cable and the elongated marker, to a second position in operative association with the elongated cable and the elongated marker to maintain the elongated marker in the deployed orientation. The apparatus preferably also includes a stop member disposed on the elongated cable at a point proximal of the elongated marker, wherein the stabilizer member is disposed between the elongated marker and the stop member, such that the elongated cable is held in tension between the stop member and the elongated marker. Preferably, the stop member is a ferrule which is attached to the elongated cable member.

[0016] A clamp is also disclosed herein which is operatively associated with the elongated cable to selectively prevent longitudinal movement of the elongated cable relative to the needle. The clamp preferably includes a screw movable from a first position, which permits longitudinal movement of the elongated cable relative to the apparatus housing, to a second position, which prevents longitudinal movement of the elongated cable relative to the apparatus housing.

[0017] The present disclosure also provides an apparatus for marking a particular location in body tissue, which includes (i) a housing, (ii) an elongated cable configured and dimensioned to pass through a longitudinal passageway defined by the housing, (iii) a tissue marker operatively connected to a distal end of the elongated

5 cable, such that movement of the elongated cable from a first position to a second position moves the marker from a retracted orientation to a deployed orientation, and (iv) a clamp operatively associated with the elongated cable to selectively prevent longitudinal movement of the elongated cable relative to the apparatus housing.

[0018] The clamp preferably includes a body portion defining a passageway therethrough to receive the elongated cable and a bias member movable from a released position, wherein the elongated cable is permitted to move longitudinally relative to the body portion and a clamped position, wherein the elongated cable is prevented from moving longitudinally relative to the body portion.

[0019] The present disclosure also provides a surgical apparatus for marking a particular location in body tissue, which includes (i) a needle assembly including a housing and an elongated tube having a sharp distal end, (ii) a marker assembly including an elongated cable configured and dimensioned to pass through a longitudinal passageway defined by the needle assembly, and an elongated tissue marker attached adjacent a distal end of the elongated cable such that the elongated marker is movable between a retracted orientation and a deployed orientation, wherein the elongated cable is sufficiently rigid to maintain the elongated tissue marker in each of said retracted and deployed orientations, and (iii) an actuator assembly operatively associated with the elongated marker, wherein movement of the actuator assembly from a first position to a second position moves the elongated marker from the retracted position to the deployed position.

[0020] The present disclosure also provides a method of marking a particular location in body tissue which includes the steps of (i) inserting an apparatus into a section of body tissue, (ii) deploying an elongated marker having an elongated cable attached thereto from the apparatus into the tissue, (iii) retaining the elongated cable relative to the distal end of the apparatus, and (iv) moving the elongated marker into an orientation substantially perpendicular to the elongated cable.

[0021] The method may further include the step of fixing the orientation of the marker in the deployed orientation.

[0022] Preferably the step of retaining the elongated cable includes clamping the elongated cable to a portion of the apparatus.

#### **BRIEF DESCRIPTION OF THE DRAWINGS**

[0023] Various embodiments are described herein with reference to the drawings, wherein:

55 FIG. 1 is a perspective view of one embodiment of the apparatus for marking a particular location in body tissue constructed in accordance with the present disclosure;

FIG. 2 is a perspective view, with parts separated, which shows the individual structural components of the embodiment of FIG. 1;

FIG. 3 is a partial perspective view, with parts separated, which shows the distal end of the cable of the embodiment of FIG. 1 and the positioning of the tissue marker thereon;

FIG. 4 is a perspective view similar to FIG. 3, which shows the tissue marker crimped in place on the distal end of the cable;

FIG. 5 is a perspective view of the distal end of the apparatus embodiment of FIG. 1, which shows the relative positioning of the cable and tissue marker within the needle of the embodiment of FIG. 1;

FIG. 6 is a partial perspective view showing the proximal end of the embodiment of FIG. 1;

FIG. 7 is an enlarged view of the indicated area of detail of FIG. 6;

FIG. 8 is a partially cut-away perspective view which shows the internal working surfaces of the actuator housing;

FIG. 9 is an enlarged partially cut-away view of the indicated area of detail of FIG. 6;

FIG. 10 is a perspective view, which shows the insertion of the embodiment of FIG. 1 in the tissue of a patient to the location of the suspect tissue;

FIG. 11 is a partial cross-sectional view of the proximal end of the embodiment of FIG. 1;

FIG. 12 is a view similar to FIG. 11, showing actuator assembly deployment of the embodiment of FIG. 1;

FIG. 13 is a partially cut-away perspective view of the distal end of the embodiment of FIG. 1, which shows the corresponding movement of the tissue marker from a distal end of the apparatus as effected by the movement of the actuator assembly indicated in FIG. 12;

FIG. 14 is a perspective view of the proximal end of the apparatus which corresponds to the view of FIG. 12;

FIG. 15 is a longitudinal cross-section view of the proximal portion of the embodiment of FIG. 1, which shows the movement of the various operational components involved in deploying the tissue marker to its fully rotationally deployed position;

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FIG. 16 is a perspective view of the proximal end of the embodiment of FIG. 1, which corresponds to the view shown in FIG. 15;

FIG. 17 is a perspective view of the distal end of the embodiment of FIG. 1, which shows the initial distally deployed position of the tissue marker immediately before rotational deployment thereof;

FIG. 18 is a view similar to FIG. 17, which shows the initial rotational deployment motion of the tissue marker;

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FIG. 19 is a view similar to FIGS. 17 and 18, which shows the complete rotational deployment of the tissue marker;

FIG. 20 is a view similar to FIG. 10, which shows the tissue marker in its full rotationally deployed position within the suspect tissue lesion;

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FIG. 21 is a longitudinal cross-sectional view of the proximal end of the embodiment of FIG. 1, which shows the release of the clamping mechanism on the cable;

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FIG. 22 is a view showing the marker and cable in place in the suspect tissue lesion with the marking apparatus removed therefrom;

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FIG. 23 is a perspective partially cut-away view, with parts separated, which shows the relationship of the crimped ferrule positioned on the cable and the stabilizing tube;

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FIG. 24 is an enlarged view of the indicated area of detail of the distal of the stabilizing tube as indicated in FIG. 23;

FIG. 25 is a cross-section view taken along section line 25-25 of FIG. 23;

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FIG. 26 is a cross-section view similar to FIG. 25, which shows the insertion of the stabilizing tube over the cable and crimped ferrule;

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FIG. 27 is a broken longitudinal cross-sectional view, which shows the stabilizing tube in position between the ferrule member and the tissue marker;

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FIG. 28 is a view similar to FIG. 22, which shows the stabilizing tube in place;

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FIG. 29 is an enlarged view of the indicated area of detail shown in FIG. 28;

FIG. 30 is enlarged view of the fully deployed marker as shown in the indicated area of detail of FIG. 28;

FIG. 31 is a perspective view of a further embodiment of an apparatus for marking a particular location in body tissue constructed in accordance with the present disclosure;

5 FIG. 32 is an enlarged view of the distal end of the embodiment of FIG. 31 as indicated by the area of detail in FIG. 31;

10 FIG. 33 is a perspective view with parts separated, which shows various components of the embodiment of FIG. 31;

15 FIG. 34 is a broken, longitudinal cross-sectional view of the embodiment of FIG. 31;

FIG. 35 is a perspective view, which shows the distal end of the embodiment of FIG. 31 with a portion of the advancing tube partially cut away;

20 FIG. 36 is a broken, longitudinal cross-sectional view showing the deployment of the tissue marker; and

25 FIG. 37 is a perspective view similar to FIG. 35, which shows the deployment of the marker as corresponds to FIG. 36.

#### DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

[0024] Preferred embodiments of the presently disclosed tissue marking apparatus will now be described in detail with reference to the drawings, in which like reference numerals designate identical or corresponding elements throughout each of the several views. Referring initially to FIGS. 1 and 2, one embodiment of an apparatus for marking a particular location in body tissue in accordance with the present disclosure is exemplified by tissue marker apparatus 100. Tissue marker apparatus 100 is particularly adapted for use in minimally invasive surgical procedures to mark the location of targeted or suspect tissue.

[0025] The presently disclosed tissue marker apparatus embodiments are illustrated as utilized to locate lesions formed within the tissue of a female breast as identified by known imaging processes, e.g., stereotactic imaging. However, it will be understood by those skilled in the art that the presently disclosed tissue marker apparatus embodiments may also be utilized to locate targeted or suspect tissue in other areas of the body as well.

[0026] Except where noted otherwise, the materials utilized in the components of the presently disclosed embodiments of apparatus for marking particular locations in body tissue generally include materials such as polycarbonate for housing sections and related components and stainless steel for components that are required to cut tissue.

[0027] Generally, tissue marker apparatus 100, when assembled into its three principle subassemblies, includes a needle assembly 110, a marker assembly 112, and an actuator assembly 114, as described in detail further herein.

[0028] As shown in FIG. 2, needle assembly 110 includes a hollow, preferably stainless steel, shaft 116 having a barrel-shaped body portion 118 mounted at a proximal end and a sharpened hollow tip 119 formed at a distal end. Body portion 118 preferably has a stepped throughbore 120 (FIG. 8) to securely receive shaft portion 116, e.g., by friction fit, which may be supplemented by bonding, adhesives or the like. Body portion 118 is further provided with a transverse slot 122 which is open at the proximal end surface of body portion 118. The significance of transverse slot 122 and the various control surfaces formed thereon are described in detail further herein.

[0029] Referring now to FIG. 2A through FIG. 5 in conjunction with FIG. 2, marker assembly 112 includes a cable 124, a stop member in the form of a ferrule 126 crimped around cable 124 at a predetermined distance from the distal end (as is explained further herein), and a tissue marker 128 crimped about the distal end portion 130.

[0030] As best illustrated in FIG. 3, tissue marker 128, in a preferred configuration, is formed to have an elongated longitudinal U-shaped channel 132 forming a pair of opposed flanges 134a and 134b. A notch 136 is formed at approximately the mid-point of flange 134a to facilitate the crimping of tissue marker 128 about the distal end portion 130 of marker 124. Tissue marker 128 could also have alternative configurations which would also facilitate its attachment to cable 124. For example, the distal end portion of tissue marker 128 could be pre-formed to have a hollow cylindrical configuration. The tissue marker could then be attached to cable 124 by, for example, swaging or welding.

[0031] Distal end portion 130 of cable 124 is provided with a series of bends to form elbows 138a, 138b, 140a, and 140b to accommodate marker assembly 112 within needle shaft 116, as shown in FIG. 5, and to facilitate deployment of tissue marker 128. Elbows 138a and 138b offset cable segment 142 a predetermined distance "X", as indicated in FIG. 3, from a proximal segment 144 of cable 124.

[0032] Thus, when tissue marker 128 is fitted over distal end portion 130 of cable 124, the portion of tissue marker 128 proximal of notch 136 is disposed entirely on one side of cable segment 142, as shown in FIG. 4. Elbows 140a and 140b offset cable segment 146 a predetermined distance "Y" from proximal cable segment 144. Distance "Y" is preferably less than distance "X", such that cable segment portion 146 fits within elongated U-shaped channel 132 and flange portions 134a and 134b are crimped about segment 146 as shown in FIG. 4. Distances "X" and "Y" are predetermined such that upon assembly with cable 124 tissue marker 128 is sub-

stantially parallel to proximal cable segment 144 the assembled cable 124 and tissue marker 128 fit within the internal diameter of needle shaft 116, as shown in FIG. 5.

[0033] Actuator assembly 114 will now be described with reference to FIG. 2 in conjunction with FIGS. 6-8. A plunger 148 is provided which includes a longitudinal throughbore formed therein. An elongated advancing tube 150 is preferably friction fitted in the distal end of the throughbore of plunger 148. Alternatively, advancing tube 150 may be secured in the throughbore of plunger 148, for example, by bonding, adhesives, sonic welding or the like.

[0034] Plunger 148 is preferably provided with transversely extending deployment arms 152. A pair of bearing surfaces 154 are formed on the proximal surface of deployment arms 152 and are preferably configured and dimensioned to facilitate ergonomic distal movement of plunger 148. For example, bearing surfaces are preferably formed to be comfortably engaged by a finger of the user. Thus deployment arms may be moved distally by the user applying pressure on bearing surfaces 154 with a finger or fingers. Plunger 148 is further provided with a reduced diameter portion 156 extending from a proximal end and having threads 158 formed at the proximal end thereof. Threads 158 engage internal threads 162 formed along the distal end inner surface of a stepped throughbore formed in marker deployment actuator 160.

[0035] A cable clamp mechanism is also provided on marker deployment actuator 160 and includes a U-shaped stainless steel clip 164 which is fitted in a transversely extending slot 166 which is open at the proximal end surface of marker deployment actuator 160. A clamp set-screw 168 also forming part of the clamp mechanism is provided to be threadably received in a threaded bore 170 formed through marker deployment actuator 160. Threaded bore 170 is formed transverse to slot 166 and extends from an inner wall of slot 166 to the outer longitudinal surface of marker deployment actuator 160. The significance of the clamp mechanism will be described in further detail herein. Preferably, clamp set screw 168 is provided with a knurled dial 172 attached to threaded portion 174 to facilitate actuation of the clamping mechanism upon rotation of knurled dial 172 by the user.

[0036] Referring temporarily back to FIG. 5, an abutment member 176, which also forms part of the actuator assembly 114, is slidably positioned on cable 124 between distal end portion 130 and crimped ferrule 126. Abutment member 176 is preferably formed as an elongated cylindrically shaped element having a longitudinal throughbore formed therein. The wall thickness of abutment member 176 is preferably greater than the wall thickness of advancing tube 150. Additionally, the throughbore of abutment member 176 is dimensioned to be only slightly greater than the outer diameter of proximal cable segment 144. For example, a suitable

tolerance between the throughbore of abutment member 176 and the outer diameter of proximal cable segment 144 is approximately .01-.05 mm. This dimensional relationship between the throughbore of abutment member 176 and proximal cable segment 144 facilitates the rotational deployment of tissue marker 128 while providing additional stability, as will be described further herein.

[0037] Actuator assembly 114 is advantageously designed to provide a two-stage actuation to place tissue marker 128 at the desired location. In the first stage, plunger 148 is moved distally to longitudinally deploy tissue marker 128 and cable 124 from the distal end of needle shaft 116. In the second stage, proximal cable segment 144 is clamped to marker deployment actuator 160 by clamp set-screw 168 and marker deployment actuator 160 is moved proximally, for example, by rotating marker deployment actuator 160 relative to plunger 148 so as to separate the two components. This motion pulls cable 124 and tissue marker 128 proximally with respect to abutment member 176. Alternatively, marker deployment actuator 160 may be slidably disposed relative to plunger 148 to effectuate the desired proximal movement.

[0038] During the second stage of actuation, it is necessary to maintain plunger 148 in a fixed relationship relative to needle assembly 110. Accordingly, body portion 118 of needle assembly 110 is provided with several control surfaces to facilitate deployment of marker assembly 112 from the distal end of needle assembly 110 and to maintain the relative positioning of plunger 148 with respect to needle assembly 110.

[0039] Referring to FIGS. 6-8, body portion 118 is provided with a series of wedge-shaped stops formed along the inner surfaces 178 and 180 of transverse slot 122. A first group of stops 182 formed in opposing relationship at the same axial disposition along inner surfaces 178 and 180 establish the initial pre-deployed position of plunger 148 which corresponds to the fully retracted position of marker assembly 112 as shown in FIG. 5. Stops 182 additionally facilitate assembly of actuator assembly 114 into body portion 118. Camming action caused by arms 152 as plunger 148 is inserted in the open end of slot 122 until the proximal surface of arms 152 pass beyond the distal face of stops 182. Once arms 152 are inserted past stops 182, opposed barrel portions 184 and 186 snap back into place, thereby preventing proximal movement of plunger 148.

[0040] A second or intermediate group of stops 188 which are somewhat smaller than stops 182 are formed along inner surfaces 178 and 180 at the same axial disposition relative to each other. Stops 188 are spaced a distance distally from stops 182 such that arms 152 are disposed between the distal face of stops 182 and the proximal-most portion of stops 188. Plunger 148 is thereby maintained at the initial pre-deployment position of marker assembly 112, as shown in FIG. 5.

[0041] A third group of stops 190 are provided along

the inner walls 178 and 180 at the same axial disposition relative to each other to define a second position for plunger 148 corresponding to a distally deployed orientation of marker assembly 112 (as shown in FIG. 13). Similar to stops 182 and 188, stops 190 are formed in the shape of a wedge to facilitate distal movement of plunger 148 by camming barrel portions 184 and 186 outwardly as arms 152 pass over stops 190. Once arms 152 pass beyond the distal faces of stops 190, barrel portions 184 and 186 return to their at rest configurations thereby preventing proximal movement of plunger 148 relative to barrel portion 118.

**[0042]** In use, as shown in FIGS. 10-22, tissue marker apparatus 100, is inserted through the breast tissue 192 of a patient with its control surfaces initially configured as shown in FIGS. 10 and 11. Tissue marker apparatus 100 is inserted such that the distal end is positioned adjacent a suspect lesion 194. The exact location of lesion 194 may be identified by any suitable known imaging apparatus or process, such as by stereotactic mammographic imaging, as is known in the art.

**[0043]** As shown in FIGS. 12-14, marker assembly 112 is deployed from its initial position, through the first stage of deployment, i.e., distal movement to completely expose tissue marker 128 relative to the sharpened tip 119 of needle shaft 116. The exposure of tissue marker 128 is facilitated by applying a distally directed force to arms 152, as indicated by arrows "A" in FIG. 12. Marker assembly 112 is configured and dimensioned to reach its distal-most longitudinally deployed position when arms 152 abut against the bottom of slot 122. Stops 190 prevent plunger 148 and, therefore, advancing tube 150, abutment member 176 and finally tissue marker 128 from movement in a proximal direction once distally deployed.

**[0044]** Cable 124 and, therefore, marker assembly 112 are fixed with respect to marker deployment actuator 160 by applying the clamp mechanism provided on marker deployment actuator 160. Specifically dial 172 is rotated, as shown in FIG. 15, to advance set-screw 168 and clamp cable 124 between the sides of U-shaped clip 164.

**[0045]** The rotational deployment of tissue marker 128 is initiated by rotation of marker deployment actuator 160 relative to body portion 118, as indicated by arrows "B", FIG. 16, in a counterclockwise fashion to unthread deployment actuator 160 from body portion 118. This rotational movement imparts proximal movement, as indicated by arrow "C" in FIG. 16, of marker deployment actuator 160 and the clamped elongated cable 124 held therein. Marker assembly 112 is thereby pulled proximally with respect to the relatively fixed abutment member 176 as indicated by arrow "D" as shown in FIG. 17. Rotation of marker deployment actuator 160 will twist cable 124 which is preferably selected to have material characteristics which permit such twisting while maintaining the necessary tensile strength to hold tissue marker 128 in the fully deployed perpendicular position,

as described below.

**[0046]** Upon continued rotation of marker deployment actuator 160 and proximal movement of marker assembly 112, cable 124 moves toward abutment member 176 so that elbows 138a and 138b (FIG. 5) are straightened due to the inner walls of the throughbore in abutment member 176 acting on the malleable cable 124. As shown in FIG. 18, once tissue marker 128 comes into abutment with the distal face of abutment member 176, continued rotation of marker deployment actuator 160, as shown in FIG. 16, causes tissue marker 128 to begin rotating in the direction indicated by arrow "E" shown in FIG. 18. This rotation is due to the offset parallel axial alignment of tissue marker 128 with respect to proximal segment 144 of cable 124 and abutment member 176.

**[0047]** Upon still further rotation of marker deployment actuator 160, tissue marker 128 becomes disposed perpendicular to abutment member 176, as shown in FIGS. 19 and 20, thereby preventing further rotation of actuator 160. The resistance to further rotation will provide indication to the user of the full deployment of tissue marker 128.

**[0048]** Once the marker assembly 112 is fully deployed as shown in FIGS. 19 and 20, the clamp mechanism may be released by unscrewing set screw 168 as shown in FIG. 21. With cable 124 released, apparatus 100 can be removed from cable 124 and the marker assembly 112 left in place as shown in FIG. 22.

**[0049]** The presently disclosed tissue marker apparatus 100 utilized in either a minimally invasive or an open biopsy procedure. In a minimally invasive procedure, the suspect tissue or lesion is preferably located by a stereotactic imaging apparatus and removed with a minimally invasive instrument used in conjunction with the stereotactic apparatus.

**[0050]** For example, the presently disclosed tissue marking apparatus 100 is designed to be used in conjunction with a minimally invasive breast biopsy device, such as is disclosed in currently pending, commonly assigned U.S. Patent Application Serial No. 08/525,450, filed on September 8, 1995 by Milliman et al., and commonly assigned, co-pending, U.S. Patent Application Serial No. , concurrently filed herewith by Milliman et al., which is a continuation-in-part application of the former cited Milliman et al. application. In such a minimally invasive biopsy procedure, the presently disclosed tissue marker apparatus 100 is deployed as set forth herein, the needle assembly 110 and actuator assembly 114 (except for the abutment member 176) are removed from the patient leaving the abutment member 176 and marker assembly 112 to mark the lesion location. Then the minimally invasive biopsy instrument embodiment adapted for use on a stereotactic imaging apparatus, as disclosed in the above-mentioned Milliman et al. applications, may be advanced into the breast using the cable 124 as a guide. The precision locating capabilities of the stereotactic imaging machine can then be used to insert the biopsy instrument to the appropriate depth

prior to actuation of the tissue removal structure.

[0051] Alternatively, the presently disclosed tissue marker apparatus 100 may be utilized in an open breast biopsy procedure, i.e., a procedure wherein the patient will likely be taken into a surgical suite after the marker is deployed. In such a procedure the lesion may be located by any suitable imaging apparatus or process, for example stereotactic imaging or ultrasound. The tissue marker 128 is then deployed as set forth above, the needle assembly 110 and the actuation assembly 114 (except for abutment member 176) are removed from the patient, preferably before transporting the patient to the operative suite, if such transportation is necessary. Marker assembly 112 is thereby left in place with the abutment member 176 disposed around cable 124 adjacent the perpendicularly disposed marker 128. When the patient is located in the operating room, a stabilizing tube 196 is provided such as the one shown in FIGS. 23-30, which will now be described in detail. The lesion is then removed by cutting away the tissue leading to the lesion and then removing the lesion.

[0052] Referring initially to FIGS. 23-25, stabilizing tube 196 is formed as an elongated hollow tube having an open distal end and a substantially frustoconical open proximal end portion, preferably formed of a series of resilient tapered arcuate segments 198. Inner diameter 199 of stabilizing tube 196 is preferably slightly larger than the outer diameter of ferrule 126 to facilitate the insertion of stabilizing tube 196 over ferrule 126.

[0053] Specifically, once tissue marker 128 is properly positioned, the user can then stabilize the location of marker 128 by inserting the proximal segment 144 of cable 124 through the open distal end of stabilizing tube 196 and sliding stabilizing tube 196 over cable 124 such that the open end thereof passes completely past ferrule 126. This causes segments 198 to cam radially outwardly as shown in FIG. 26.

[0054] Referring to FIG. 27, once the proximal end of stabilizing tube 196 passes distal of the distal end of ferrule 126, segments 198 are restored to their initial configuration thereby locking stabilizing tube 196 between ferrule 126 and abutment member 176. Tissue marker 128 is thus maintained perpendicular to abutment member 176 as shown in FIGS. 27-30 and cable 124 and is held in tension. Thereafter,

[0055] A further embodiment of a surgical apparatus for marking a particular location in body tissue constructed in accordance with the present disclosure will now be described with reference to FIGS. 31-37. Referring to FIGS. 31-33, tissue marker apparatus 200 includes a needle 210 having a sharpened distal end point 211 and a cable 224 secured to a proximal end of needle 210. Tip 211 is preferably conically shaped and extends beyond the diameter of body portion 213 of needle 210 forming an annular shoulder 215 (FIG. 36). A tissue marker 228 is slidably disposed over body portion 213 of needle 210 and is positioned in abutment with annular shoulder 215. An abutment member 276 is having a lon-

5 gitudinal throughbore is slidably disposed over body portion 213 of needle 210, adjacent the proximal end of tissue marker 228. The aforementioned assembly of components is passed through an advancing tube 250 which is securely mounted, e.g., by friction fit in the distal portion of a stepped throughbore formed in a housing 248. Housing 248 is provided with transversely extending projections 252 at a proximal end thereof and proximally extending threaded portion 256. A marker deployment actuator 260 having a longitudinal throughbore formed therein with threads formed along the inner surface near the distal end of the longitudinal throughbore is threadably mounted on threaded portion 256 of body 248. End cap 271 is provided having a longitudinal throughbore formed therein to receive cable 224 therethrough. A set screw 268 is also provided and is threadably received in a transverse threaded bore formed through the sidewall of cap 271 to clamp cable 224 to cap 271 so as to maintain connection of needle 210 and tissue marker 228 to tissue marker apparatus 200.

[0056] Tissue marker 228 preferably has a series of longitudinal slats 273 which may be formed as bisected segments connected by a reduced cross-sectional dimension portion, commonly referred to as a "living hinge" 275, to facilitate expansion of slats 273 upon deployment of tissue marker 228.

[0057] In use, as shown in FIGS. 36 and 37, tissue marking apparatus 200 is inserted in the patient's breast in a manner similar to that for tissue marker apparatus 100 in the previously described embodiment. Once tissue marker 228 is positioned adjacent the suspect lesion, marker deployment actuator 260 is rotated, as indicated by arrow "G" in FIG. 36. This rotational motion causes marker deployment actuator 260 to move in a proximal direction, as indicated by arrow "H", due to the threading of marker deployment actuator 160 and body 248. With cable 224 held fixed relative to marker deployment actuator 260 by set screw 268, body portion 213 of needle 210 is also pulled proximally as indicated by arrow "H" shown in FIG. 36. Tissue marker 228 is thereby compressed causing slats 273 to expand radially outwardly thereby marking the suspect lesion location.

[0058] It will be understood that various modifications may be made to the embodiments disclosed herein. For example, the cable is preferably formed of an elongated wire segment, however numerous different types of cable may be utilized, such as multi-strand braided wire. Therefore, the above description should not be construed as limiting, but merely as exemplifications of preferred embodiments. Those skilled in the art will envision other modifications.

## Claims

55 1. A tissue marking apparatus for marking a particular location in body tissue for subsequent surgical procedure, which comprises:

- a needle (110; 250) including a housing (118; 248) and an elongated tube (116; 250) having a sharp distal end (119; 211), the housing and elongated tube forming an longitudinal passageway therethrough;
- an elongated cable (124; 224) configured and dimensioned to pass through the longitudinal passageway;
- an elongated tissue marker (128; 228) attached adjacent a distal end of the elongated cable such that the elongated marker is movable between a retracted orientation and a deployed orientation; and
- an actuator assembly (148, 160, 176; 248, 260, 276) operatively associated with the elongated marker;

**characterized by**

- an abutment member (176; 276) which forms part of the actuator assembly, and is slidably positioned around the elongated cable and inside the needle whereby the elongated marker is moved from its retracted orientation to its deployed orientation, by abutment of the elongated marker with the abutment member and by actuating the actuator assembly to pull proximally on the elongated cable; and further

**characterised by**

- a cable clamp mechanism (168, 268) on the actuator assembly, for pulling the cable proximally relative to the abutment member, in order to move the marker from its retracted to its deployed orientation.

2. A tissue marking apparatus for marking a particular location in body tissue according to claim 1, wherein in the deployed orientation at least a pair of opposed parts (273) of the tissue marker (128; 228) expands radially outwardly in substantially opposite directions relative to the longitudinal axis of the elongated cable (124; 224).

3. A tissue marking apparatus for marking a particular location in body tissue according to claim 1 or 2, wherein when the elongated marker (128; 228) is in the retracted position a longitudinal axis of the elongated marker (128; 228) is substantially parallel to a longitudinal axis of the elongated cable (124; 224).

4. A tissue marking apparatus for marking a particular location in body tissue according to one of the previous claims 1 to 3, wherein when the elongated marker (128; 228) is in the deployed position a longitudinal axis of the elongated marker (128; 228) is

substantially perpendicular to a longitudinal axis of the elongated cable (124; 224).

5. A tissue marking apparatus for marking a particular location in body tissue according to one of the previous claims 1 to 4, wherein the elongated marker (128; 228) is collapsible from the retracted position, wherein the elongated marker (128; 228) forms a substantially uniform transverse dimension with an outer surface of the elongated needle tube (116; 250) to the deployed position wherein the elongated marker (128; 250) has a transverse dimension which is substantially greater than that of the outer surface of the elongated needle tube (116; 250).

6. A tissue marking apparatus for marking a particular location in body tissue according to one of the previous claims 1 to 5, wherein the actuator assembly (148, 160, 176; 248, 260, 276) includes a first deployment actuator (148; 248) operatively connected to the housing (118; 248) and a second deployment actuator (160; 260) operatively associated with the first deployment actuator (148; 248).

7. A tissue marking apparatus for marking a particular location in body tissue according to claim 6, wherein the actuator assembly (148, 160, 176; 248, 260, 276) further includes an advancing tube (150; 250) disposed between the first deployment actuator (148; 248) and the elongated marker (128; 228).

8. A tissue marking apparatus for marking a particular location in body tissue according to claim 6 or 7, wherein the first deployment actuator (148) is slidably with respect to the housing (118).

9. A tissue marking apparatus for marking a particular location in body tissue according to one of the previous claims 6 to 8, wherein distal movement of the first deployment actuator (148) moves the elongated marker (128) from the retracted position to a longitudinally deployed position a predetermined distance away from a distal end of the sharp distal end (119) of the elongated tube (116).

10. A tissue marking apparatus for marking a particular location in body tissue according to one of the previous claims 6 to 9, wherein movement of the second deployment actuator (160) from a first position to a second position rotates the elongated marker (128) from a first orientation to a second orientation.

11. A tissue marking apparatus for marking a particular location in body tissue according to one of the previous claims 1 to 10, which comprises:

- a stabilizer member (196) which is moved from a first position relative to the elongated cable

(124) and the elongated marker (128), to a second position in operative association with the elongated cable (124) and the elongated marker (128) to maintain the elongated marker (128) in the deployed orientation. 5

12. A tissue marking apparatus for marking a particular location in body tissue according to claim 11, which further comprises a stop member (126) disposed on the elongated cable (124) at a point proximal of the elongated marker (128), wherein the stabilizer member (126) is disposed between the elongated marker (128) and the stop member (126) such that the elongated cable (124) is held in tension between the stop member (126) and the elongated marker (128). 10

13. A tissue marking apparatus for marking a particular location in body tissue according to claim 12, wherein the stop member (126) is a ferrule (126) which is attached to the elongated cable member (124). 15

14. A tissue marking apparatus for marking a particular location in body tissue according to one of the previous claims 1 to 13, which further comprises a clamp (164, 168; 271, 268) operatively associated with the elongated cable (124; 224) to selectively prevent longitudinal movement of the elongated cable (124; 224) relative to the needle (110; 250). 20

15. A tissue marking apparatus for marking a particular location in body tissue according to claim 14, wherein the clamp (164, 168; 271, 268) includes a screw (168; 268) movable from a first position which permits longitudinal movement of the elongated cable (124; 224) relative to the apparatus housing (160; 260), to a second position which prevents longitudinal movement of the elongated cable (124; 224) relative to the apparatus housing (160; 260). 25

16. A tissue marking apparatus for marking a particular location in body tissue according to claim 14 or 15, wherein 30

- a tissue marker (128; 228) is operatively connected to a distal end of the elongated cable (124; 224) such that movement of the elongated cable (124; 224) from a first position to a second position moves the marker (128; 228) from a retracted orientation to a deployed orientation; and 35
- said clamp (164, 168; 271, 268) is operatively associated with the elongated cable (124; 224) to selectively prevent longitudinal movements of the elongated cable (124; 224) relative to the apparatus housing (160; 260). 40

17. A tissue marking apparatus for marking a particular location in body tissue, according to claim 16, wherein the clamp (164, 168; 271, 268) is connected to the apparatus housing (160; 260). 45

18. A tissue marking apparatus for marking a particular location in body tissue, according to claims 14 to 17, wherein the clamp (271, 268) includes a body portion (271) defining a passageway therethrough to receive the elongated cable (224) and a bias member (268) movable from a released position, wherein the elongated cable (224) is permitted to move longitudinally relative to the body portion (271) and a clamped position, wherein the elongated cable (224) is prevented from moving longitudinally relative to the body portion (271). 50

19. A tissue marking apparatus for marking a particular location in body tissue, according to claim 18, wherein the bias member (268) is a screw (268) threadably positioned in a bore formed in the body portion (271). 55

20. A tissue marking apparatus for marking a particular location in body tissue according to one of the previous claims 1 to 19, wherein the elongated cable (124; 224) is sufficiently rigid to maintain the elongated tissue marker (128; 228) in each of said retracted and deployed orientations. 60

#### Patentansprüche

1. Eine Gewebemarkiervorrichtung zum Markieren einer besonderen Stelle in Körpergewebe für ein anschließendes chirurgisches Verfahren, umfassend:

eine Nadel (110, 250), die ein Gehäuse (118, 248) und ein länglich ausgebildetes Rohr (116, 250) mit einem spitzen distalen Ende (119, 211) umfasst, wobei das Gehäuse und das länglich ausgebildete Rohr eine längliche Durchführung hierdurch bilden;

ein länglich ausgebildetes Kabel (124, 224), das durch die längliche Durchführung verläuft;

ein länglich ausgebildetes Gewebemarkierelement (128, 228), das benachbart einem distalen Ende des länglich ausgebildeten Kabels derart angebracht ist, dass das länglich ausgebildete Markierelement zwischen einer zurückgezogenen Orientierung und einer Einsatzorientierung bewegbar ist; und

eine Betätigungsseinrichtung (148, 160, 176; 248, 260, 276), die betriebsmäßig mit dem länglich ausgebildeten Markierelement verbun-

den ist;

**gekennzeichnet durch**

ein Gegenlagerelement (176, 276), das einen Teil der Betätigungseinrichtung bildet, und das gleitbar um das länglich ausgebildete Kabel und innerhalb der Nadel positioniert ist, wobei das länglich ausgebildete Markierelement von seiner zurückgezogenen Orientierung in seine Einsatzorientierung

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durch Anstoßen des länglich ausgebildeten Markierelements an das Gegenlagerelement und durch Betätigen der Betätigungseinrichtung, um an dem länglich ausgebildeten Kabel in proximaler Richtung zu ziehen, bewegt wird; und des weiteren

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**gekennzeichnet durch**  
einen Kabelklemmmechanismus (168, 268) auf der Betätigungseinrichtung zum Ziehen des Kabels in proximaler Richtung relativ zu dem Gegenlagerelement, um das Markierelement von seiner zurückgezogenen Orientierung in seine Einsatzorientierung zu bewegen.

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2. Eine Gewebemarkiervorrichtung zum Markieren einer besonderen Stelle in Körpergewebe nach Anspruch 1, wobei in der Einsatzorientierung zumindest ein Paar gegenüberliegender Teile (273) des Gewebemarkierelements (128, 228) sich in radialer Richtung nach außen in im Wesentlichen entgegengesetzte Richtungen relativ zur Längsachse des länglich ausgebildeten Kabels (124, 224) ausdehnen.

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3. Eine Gewebemarkiervorrichtung zum Markieren einer besonderen Stelle in Körpergewebe nach Anspruch 1 oder 2, wobei eine Längsachse des länglich ausgebildeten Markierelements (128, 228) im Wesentlichen parallel zu einer Längsachse des länglich ausgebildeten Kabels (124, 224) ist, wenn sich das länglich ausgebildete Markierelement (128, 228) in der zurückgezogenen Position befindet.

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4. Eine Gewebemarkiervorrichtung zum Markieren einer besonderen Stelle in Körpergewebe nach einem der vorhergehenden Ansprüche, wobei eine Längsachse des länglich ausgebildeten Markierelements (128, 228) im Wesentlichen senkrecht zu einer Längsachse des länglich ausgebildeten Kabels (124, 224) ist, wenn sich das länglich ausgebildete Markierelement (128, 228) in der Einsatzposition befindet.

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5. Eine Gewebemarkiervorrichtung zum Markieren einer besonderen Stelle in Körpergewebe nach einem der vorhergehenden Ansprüche, wobei das länglich ausgebildete Markierelement (128, 228) von der zurückgezogenen Position, in der das länglich ausgebildete Markierelement (128, 228) eine

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im Wesentlichen gleichmäßige seitliche Abmessung mit einer Außenoberfläche des länglich ausgebildeten Nadelrohrs (116, 250) bildet, zur Einsatzposition, in der das länglich ausgebildete Markierelement (128, 250) eine seitliche Abmessung aufweist, die im Wesentlichen größer als die der Außenoberfläche des länglich ausgebildeten Nadelrohrs (116, 250) ist, kollabierbar ist.

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6. Eine Gewebemarkiervorrichtung zum Markieren einer besonderen Stelle in Körpergewebe nach einem der vorhergehenden Ansprüche, wobei die Betätigungseinrichtung (148, 160, 176; 248, 260, 276) ein erstes Einsatz-Betätigungslement (148, 248), das betriebsmäßig mit dem Gehäuse (118, 248) verbunden ist, und ein zweites Einsatz-Betätigungslement (160, 260), das betriebsmäßig mit dem ersten Einsatz-Betätigungslement (148, 248) verbunden ist, umfasst.

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7. Eine Gewebemarkiervorrichtung zum Markieren einer besonderen Stelle in Körpergewebe nach Anspruch 6, wobei die Betätigungseinrichtung (148, 160, 176; 248, 260, 276) des weiteren ein Vorwärtsbewegungs-Rohr (150, 250) umfasst, das zwischen dem ersten Einsatz-Betätigungslement (148, 248) und dem länglich ausgebildeten Markierelement (128, 228) angeordnet ist.

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8. Eine Gewebemarkiervorrichtung zum Markieren einer besonderen Stelle in Körpergewebe nach Anspruch 6 oder 7, wobei das erste Einsatz-Betätigungslement (148) gleitbar in Bezug auf das Gehäuse (118) ist.

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9. Eine Gewebemarkiervorrichtung zum Markieren einer besonderen Stelle in Körpergewebe nach einem der vorhergehenden Ansprüche 6 bis 8, wobei eine distale Bewegung des ersten Einsatz-Betätigungslements (148) das länglich ausgebildete Markierelement (128) von der zurückgezogenen Position in eine in Längsrichtung gelegene Einsatzposition bewegt, die um einen vorbestimmten Abstand von einem distalen Ende des spitzen distalen Endes (119) des länglich ausgebildeten Rohres (116) beabstandet ist.

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10. Eine Gewebemarkiervorrichtung zum Markieren einer besondere Stelle in Körpergewebe nach einem der Ansprüche 6 bis 9, wobei eine Bewegung des zweiten Einsatz-Betätigungslements (160) von einer ersten Position in eine zweite Position das länglich ausgebildete Markierelement (128) von einer ersten Orientierung in eine zweite Orientierung dreht.

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11. Eine Gewebemarkiervorrichtung zum Markieren einer besonderen Stelle in Körpergewebe nach ei-

nem der vorhergehenden Ansprüche 1 bis 10, umfassend:

ein Stabilisierungselement (196), das von einer ersten Position relativ zu dem länglich ausgebildeten Kabel (124) und dem länglich ausgebildeten Markierelement (128) in eine zweite Position betriebsmäßig zusammen mit dem länglich ausgebildeten Kabel (124) und dem länglich ausgebildeten Markierelement (128) bewegt wird, um das länglich ausgebildete Markierelement (128) in der Einsatz-Orientierung zu halten.

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12. Eine Gewebemarkiervorrichtung zum Markieren einer besonderen Stelle in Körpergewebe nach Anspruch 11, des weiteren umfassend ein Anschlagselement (126), das an dem länglich ausgebildeten Kabel (124) an einem Punkt proximal von dem länglich ausgebildeten Markierelement (128) angeordnet ist, und wobei das Stabilisierungselement (126) zwischen dem länglich ausgebildeten Markierelement (128) und dem Anschlagselement (126) angeordnet ist, so dass das länglich ausgebildete Kabel (124) zwischen dem Anschlagselement (126) und dem länglich ausgebildeten Markierelement (128) straff gehalten wird.

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13. Eine Gewebemarkiervorrichtung zum Markieren einer besonderen Stelle in Körpergewebe nach Anspruch 12, wobei das Anschlagselement (126) eine Ferrüle (126) ist, die an dem länglich ausgebildeten Kabelelement (124) angebracht ist.

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14. Eine Gewebemarkiervorrichtung zum Markieren einer besonderen Stelle in Körpergewebe nach einem der vorhergehenden Ansprüche 1 bis 13, des weiteren umfassend eine Klemme (164, 168; 271, 268), die betriebsmäßig mit dem länglich ausgebildeten Kabel (124, 224) verbunden ist, um gezielt eine Längsbewegung des länglich ausgebildeten Kabels (124, 224) relativ zu der Nadel (110, 250) zu verhindern.

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15. Eine Gewebemarkiervorrichtung zum Markieren einer besonderen Stelle in Körpergewebe nach Anspruch 14, wobei die Klemme (164, 168; 271, 268) eine Schraube (168, 268) umfasst, die von einer ersten Position, in der eine Längsbewegung des länglich ausgebildeten Kabels (124, 224) relativ zu dem Vorrichtungsgehäuse (160, 260) möglich ist, in eine zweite Position, in der eine Längsbewegung des länglich ausgebildeten Kabels (124, 224) relativ zu dem Vorrichtungsgehäuse (160, 260) verhindert ist, bewegbar ist.

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16. Eine Gewebemarkiervorrichtung zum Markieren einer besonderen Stelle in Körpergewebe nach An-

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spruch 14 oder 15, wobei

- ein Gewebemarkierelement (128, 228) betriebsmäßig mit einem distalen Ende des länglich ausgebildeten Kabels (124, 224) derart verbunden ist, so dass eine Bewegung des länglich ausgebildeten Kabels (124, 224) von einer ersten Position in eine zweite Position das Markierelement (128, 228) von einer zurückgezogenen Orientierung in eine Einsatz-Orientierung bewegt; und

- die Klemme (164, 168; 271, 268) betriebsmäßig mit dem länglich ausgebildeten Kabel (124, 224) verbunden ist, um gezielt eine Längsbewegung des länglich ausgebildeten Kabels (124, 224) relativ zu dem Vorrichtungsgehäuse (160, 260) zu verhindern.

20 17. Eine Gewebemarkiervorrichtung zum Markieren einer besonderen Stelle in Körpergewebe nach Anspruch 16, wobei die Klemme (164, 168; 271, 268) mit dem Vorrichtungsgehäuse (160, 260) verbunden ist.

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18. Eine Gewebemarkiervorrichtung zum Markieren einer besonderen Stelle in Körpergewebe nach einem der Ansprüche 14 bis 17, wobei die Klemme (271, 268) einen Körperabschnitt (271), der eine Durchführung hierdurch bestimmt, um das länglich ausgebildete Kabel (224) aufzunehmen, und ein Vorspannelement (268) umfasst, das von einer freigegebenen Position, in der das länglich ausgebildete Kabel (224) in Längsrichtung relativ zu dem Körperabschnitt (271) bewegbar ist, und einer geklemmten Position, in der das länglich ausgebildete Kabel (224) nicht in Längsrichtung relativ zu dem Körperabschnitt (271) bewegbar ist, bewegbar ist.

40 19. Eine Gewebemarkiervorrichtung zum Markieren einer besonderen Stelle in Körpergewebe nach Anspruch 18, wobei das Vorspannelement (268) eine Schraube (268) ist, die gewindemäßig im Eingriff mit einer in dem Körperabschnitt (271) gebildeten Bohrung ist.

20. Eine Gewebemarkiervorrichtung zum Markieren einer besonderen Stelle in Körpergewebe nach einem der vorhergehenden Ansprüche 1 bis 19, wobei das länglich ausgebildete Kabel (124, 224) ausreichend steif ausgebildet ist, um das länglich ausgebildete Gewebemarkierelement (128, 228) in der zurückgezogenen Orientierung und der Einsatz-Orientierung zu halten.

**Revendications**

1. Appareil de marquage de tissu pour marquer un emplacement particulier dans un tissu corporel en vue d'une intervention chirurgicale suivante, qui comprend :

- une aiguille (110 ; 250) comportant un boîtier (118 ; 248) et un tube oblong (116 ; 250) présentant une extrémité distale tranchante (119 ; 211), le boîtier et le tube oblong formant un passage longitudinal à travers celui-ci ;
- un câble oblong (124 ; 224) configuré et dimensionné pour passer à travers le passage longitudinal ;
- un marqueur de tissu oblong (128 ; 228) attaché pour être adjacent à une extrémité distale d'un câble allongé de sorte que le marqueur oblong est déplaçable entre une orientation rétractée et une orientation déployée ; et
- un ensemble d'actionneurs (148, 160, 176 ; 248, 260, 276) fonctionnellement associés au marqueur oblong ;

**caractérisé par**

- un élément de butée (176 ; 276) qui fait partie de l'ensemble d'actionneurs et qui est positionné d'une manière coulissante autour du câble oblong et à l'intérieur de l'aiguille par quoi le marqueur oblong est déplacé de son orientation rétractée à son orientation déployée, par une butée du marqueur oblong contre l'élément de butée et en actionnant l'ensemble d'actionneurs pour tirer proximalement sur le câble oblong ; et en outre

**caractérisé par**

- un mécanisme de serrage de câble (168 ; 268) sur l'ensemble d'actionneurs pour tirer le câble proximalement relativement à l'élément de butée, pour déplacer le marqueur de son orientation rétractée à son orientation déployée.

2. Appareil de marquage de tissu pour marquer un emplacement particulier dans un tissu corporel selon la revendication 1, où dans l'orientation déployée, au moins une paire de parties opposées (273) du marqueur de tissu (128 ; 228) s'étend radialement vers l'extérieur dans des directions sensiblement opposées relativement à l'axe longitudinal du câble oblong (124 ; 224).

3. Appareil de marquage de tissu pour marquer un

emplacement particulier dans un tissu corporel selon la revendication 1 ou 2, où lorsque le marqueur oblong (128 ; 228) se trouve dans la position rétractée, un axe longitudinal du marqueur oblong (128 ; 228) est sensiblement parallèle à un axe longitudinal du câble oblong (124 ; 224).

4. Appareil de marquage de tissu pour marquer un emplacement particulier dans un tissu corporel selon l'une des revendications précédentes 1 à 3, où lorsque le marqueur oblong (128 ; 228) se trouve dans la position déployée, un axe longitudinal du marqueur oblong (128 ; 228) est sensiblement perpendiculaire à un axe longitudinal du câble oblong (124 ; 224).

5. Appareil de marquage de tissu pour marquer un emplacement particulier dans tissu corporel selon l'une des revendications précédentes 1 à 4, où le marqueur oblong (128 ; 228) est pliable à partir de la position rétractée, où le marqueur oblong (128 ; 228) forme une dimension transversale sensiblement uniforme avec une surface externe du tube d'aiguille oblong (116 ; 250) à la position déployée où le marqueur oblong (128 ; 250) a une dimension transversale qui est sensiblement plus grande que celle de la surface externe du tube d'aiguille oblong (116 ; 250).

6. Appareil de marquage de tissu pour marquer un emplacement particulier dans un tissu corporel selon l'une des revendications précédentes 1 à 5, où l'ensemble d'actionneurs (148, 160, 176 ; 248, 260, 276) comporte un premier actionneur de déploiement (148 ; 248) fonctionnellement relié au boîtier (118 ; 248) et un deuxième actionneur de déploiement (160 ; 260) fonctionnellement relié au premier actionneur de déploiement (148 ; 248).

7. Appareil de marquage de tissu pour marquer un emplacement particulier dans un tissu corporel selon la revendication 6, où l'ensemble d'actionneurs (148, 160, 176 ; 248, 260, 276) comporte en outre un tube d'avancement (150 ; 250) disposé entre le premier actionneur de déploiement (148 ; 248) et le marqueur oblong (128 ; 228).

8. Appareil de marquage de tissu pour marquer un emplacement particulier dans un tissu corporel selon la revendication 6 ou 7, où le premier actionneur de déploiement (148) peut coulisser par rapport au boîtier (118).

9. Appareil de marquage de tissu pour marquer un emplacement particulier dans un tissu corporel selon l'une des revendications précédentes 6 à 8, où le mouvement distal du premier actionneur de déploiement (148) déplace le marqueur oblong (128

de la position rétractée à une position longitudinalement déployée selon une distance prédéterminée au loin d'une extrémité distale de l'extrémité distale tranchante (119) du tube oblong (116).

10. Appareil de marquage de tissu pour marquer un emplacement particulier dans un tissu corporel selon l'une des revendications précédentes 6 à 9, où un déplacement du second actionneur de déploiement (160) d'une première position à une seconde position fait tourner le marqueur oblong (128) d'une première orientation à une seconde orientation.

11. Appareil de marquage de tissu pour marquer un emplacement particulier dans un tissu corporel selon l'une des revendications précédentes 1 à 10, qui comprend :

- un élément de stabilisation (196) qui est déplacé d'une première position relativement au câble oblong (124) et au marqueur oblong (128) à une seconde position fonctionnellement associée au câble oblong (124) et au marqueur oblong (128) pour maintenir le marqueur oblong (128) dans l'orientation déployée.

12. Appareil de marquage de tissu pour marquer un emplacement particulier dans un tissu corporel selon la revendication 11, qui comprend en outre un élément d'arrêt (126) disposé sur le câble oblong (124) à un point proximal du marqueur oblong (128), où l'élément de stabilisation (126) est disposé entre le marqueur oblong (128) et l'élément d'arrêt (126) de sorte que le câble oblong (124) est maintenu en tension entre l'élément d'arrêt (126) et le marqueur oblong (128).

13. Appareil de marquage de tissu pour marquer un emplacement particulier dans un tissu corporel selon la revendication 12, où l'élément d'arrêt (126) est une ferrure annulaire (126) qui est attachée à l'élément de câble oblong (124).

14. Appareil de marquage de tissu pour marquer un emplacement particulier dans un tissu corporel selon l'une des revendications précédentes 1 à 13, qui comprend en outre un organe de serrage (164, 168 ; 271, 268) fonctionnellement associé au câble oblong (124 ; 224) pour empêcher sélectivement un déplacement longitudinal du câble oblong (124 ; 224) relativement à l'aiguille (110 ; 250).

15. Appareil de marquage de tissu pour marquer un emplacement particulier dans un tissu corporel selon la revendication 14, où l'organe de serrage (164, 168 ; 271, 268) comporte une vis (168 ; 268) déplaçable d'une première position qui permet un déplacement longitudinal du câble oblong (124 ; 224) re-

lativement au boîtier de l'appareil (160 ; 260) à une seconde position qui empêche un déplacement longitudinal du câble oblong (124 ; 224) relativement au boîtier d'appareil (160 ; 260).

16. Appareil de marquage de tissu pour marquer un emplacement particulier dans un tissu corporel selon la revendication 14 ou 15, où

- un marqueur de tissu (128 ; 228) est fonctionnellement relié à une extrémité distale du câble oblong (124 ; 224) de sorte qu'un déplacement du câble oblong (124 ; 224) d'une première position à une seconde position déplace le marqueur (128 ; 228) d'une orientation rétractée à une orientation déployée ; et
- ledit organe de serrage (164, 168 ; 271, 268) est fonctionnellement associé au câble oblong (124 ; 224) pour empêcher sélectivement des mouvements longitudinaux du câble oblong (124 ; 224) relativement au boîtier d'appareil (160 ; 260).

25 17. Appareil de marquage de tissu pour marquer un emplacement particulier dans un tissu corporel selon la revendication 16, où l'organe de serrage (164, 168 ; 271, 268) est relié au boîtier (160 ; 260) de l'appareil.

30 18. Appareil de marquage de tissu pour marquer un emplacement particulier dans un tissu corporel selon les revendications 14 à 17, où l'organe de serrage (271, 268) comporte une portion de corps (271) définissant un passage à travers celui-ci pour recevoir le câble oblong (224) et un élément de sollicitation (268) déplaçable d'une position relâchée, où le câble oblong (224) peut se déplacer longitudinalement relativement à la portion de corps (271) et une position serrée, où le câble oblong (224) est empêché de se déplacer longitudinalement relativement à la portion de corps (271).

35 19. Appareil de marquage de tissu pour marquer un emplacement particulier dans un tissu corporel selon la revendication 18, où l'élément de sollicitation (268) est une vis (268) positionnée par vissage dans un perçage ménagé dans la portion de corps (271).

40 20. Appareil de marquage de tissu pour marquer un emplacement particulier dans un tissu corporel selon l'une des revendications précédentes 1 à 19, où le câble oblong (124 ; 224) est suffisamment rigide pour maintenir le marqueur de tissu oblong (128 ; 228) dans chacune desdites orientations rétractée et déployée.

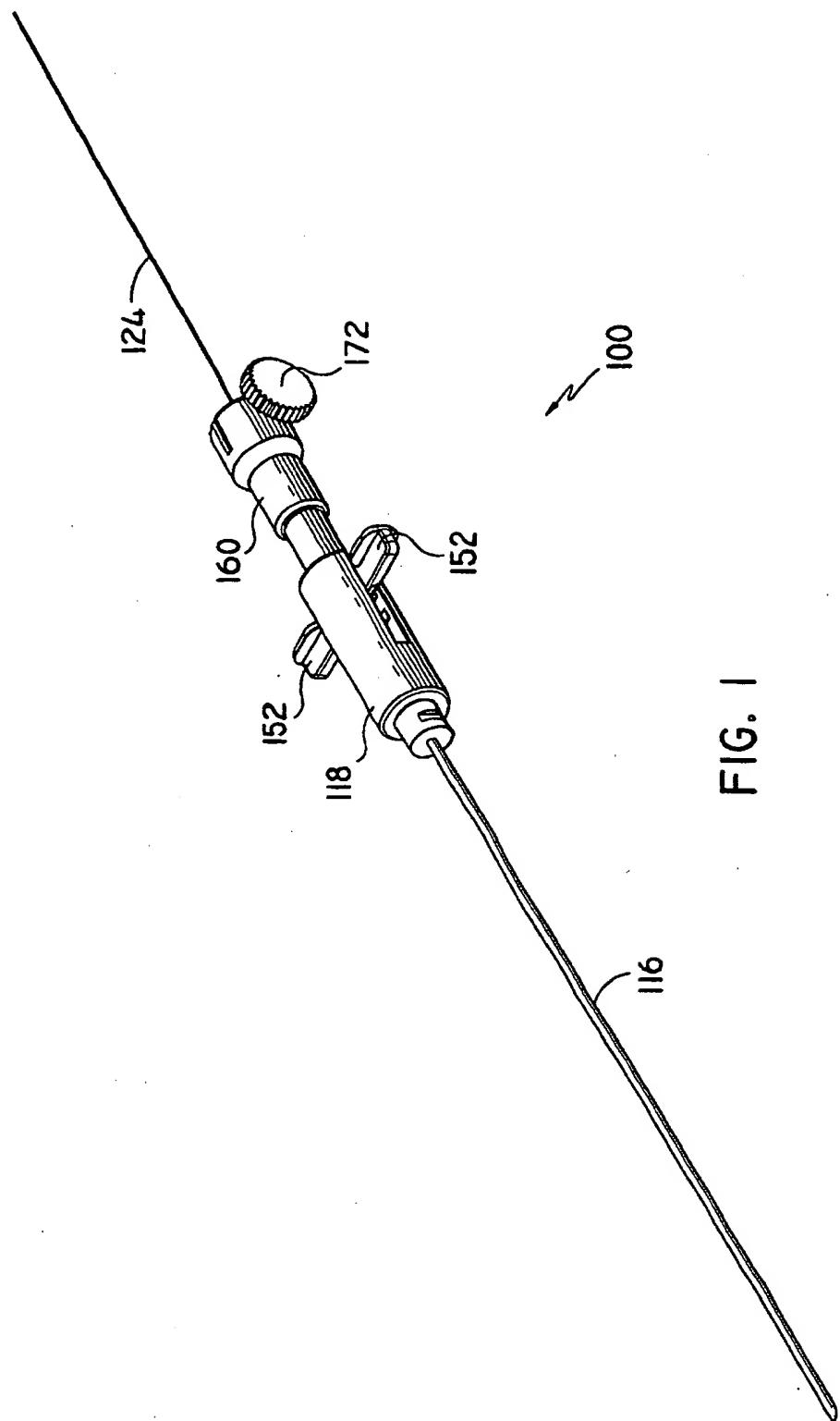
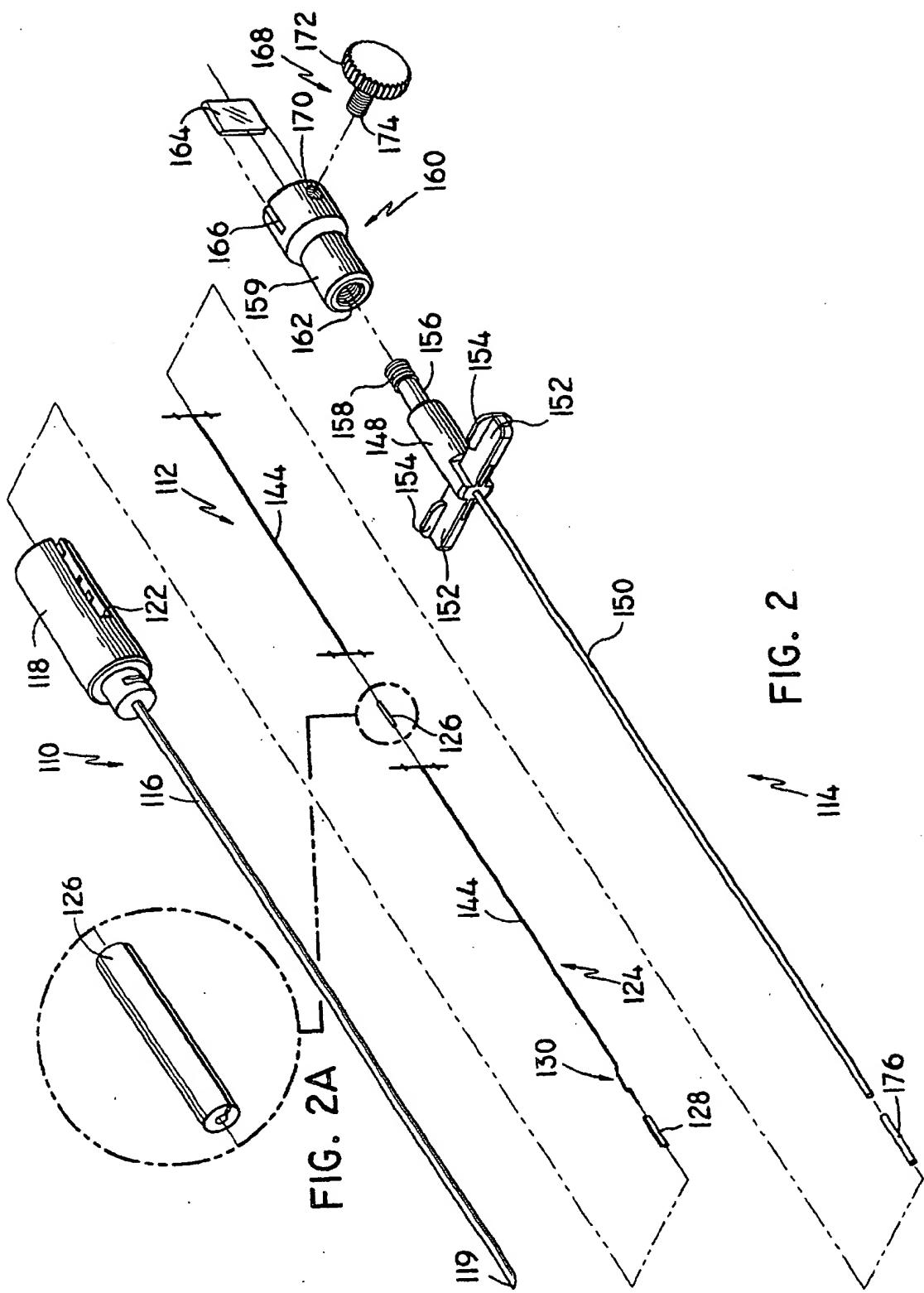
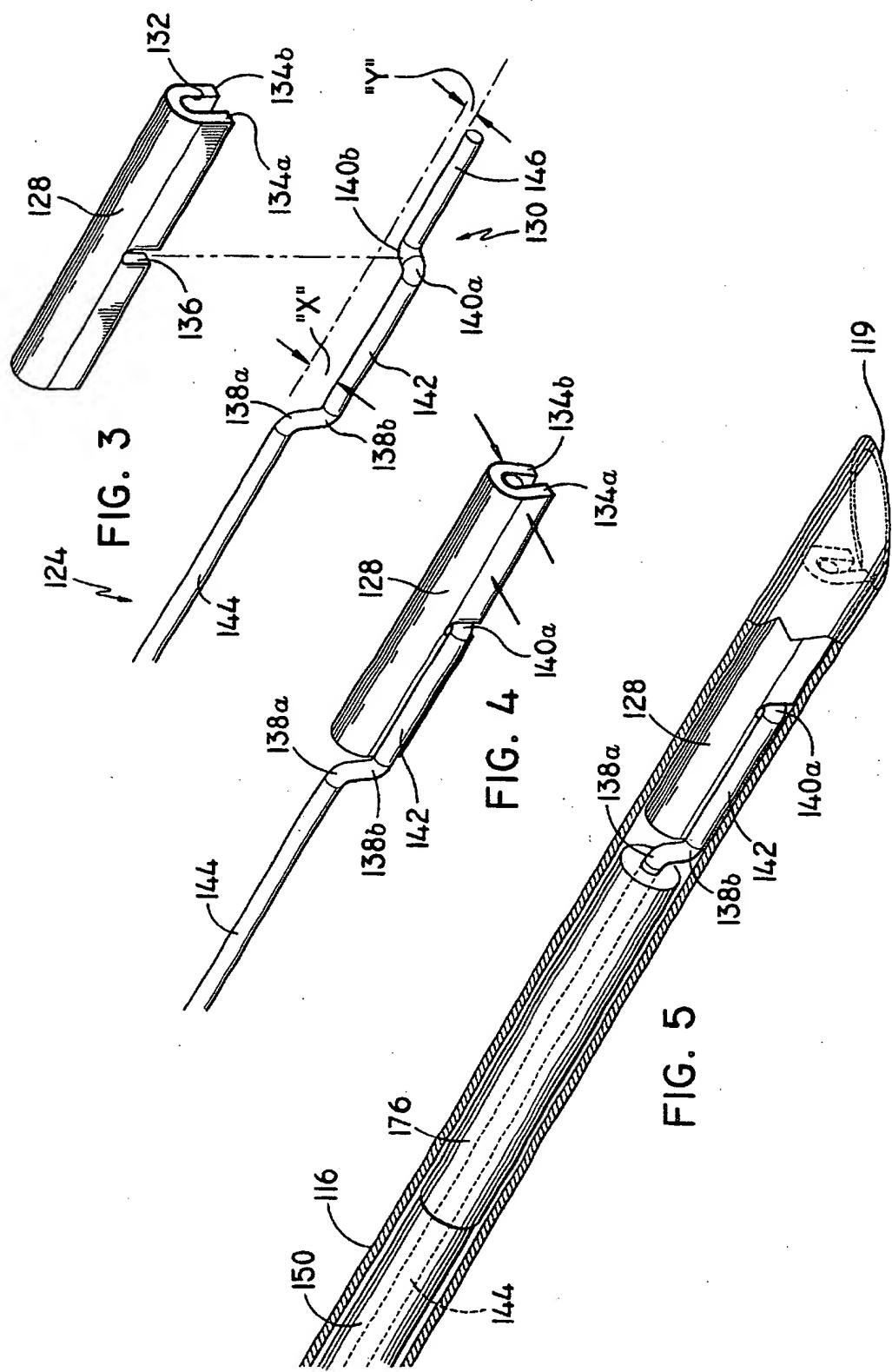
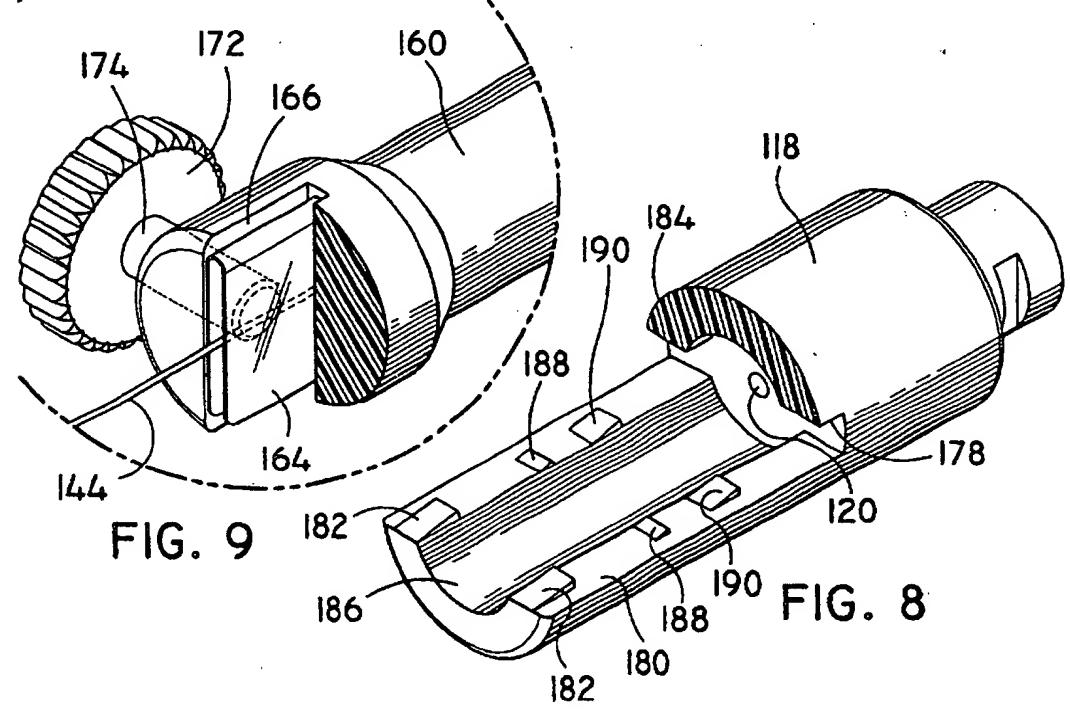
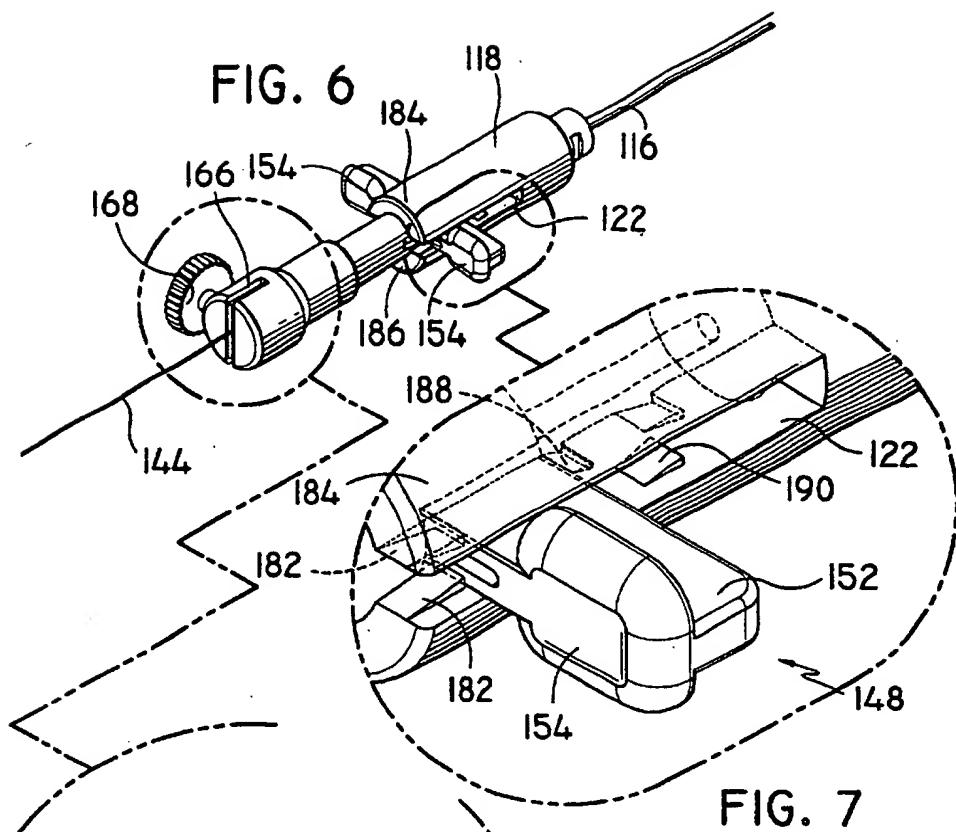


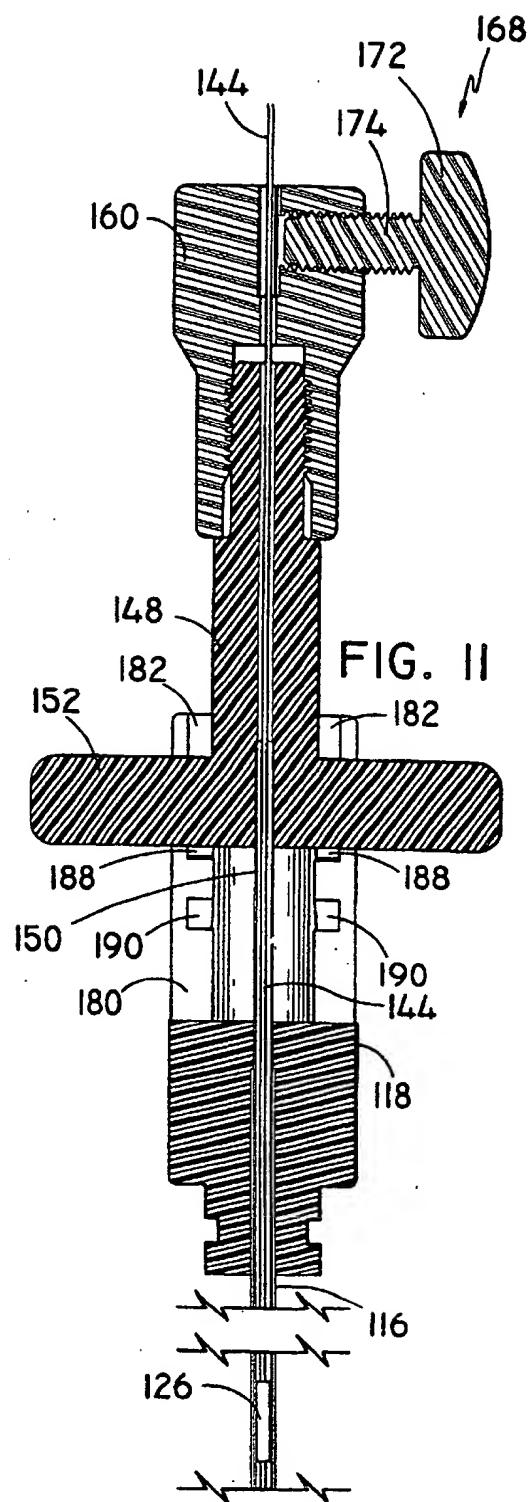
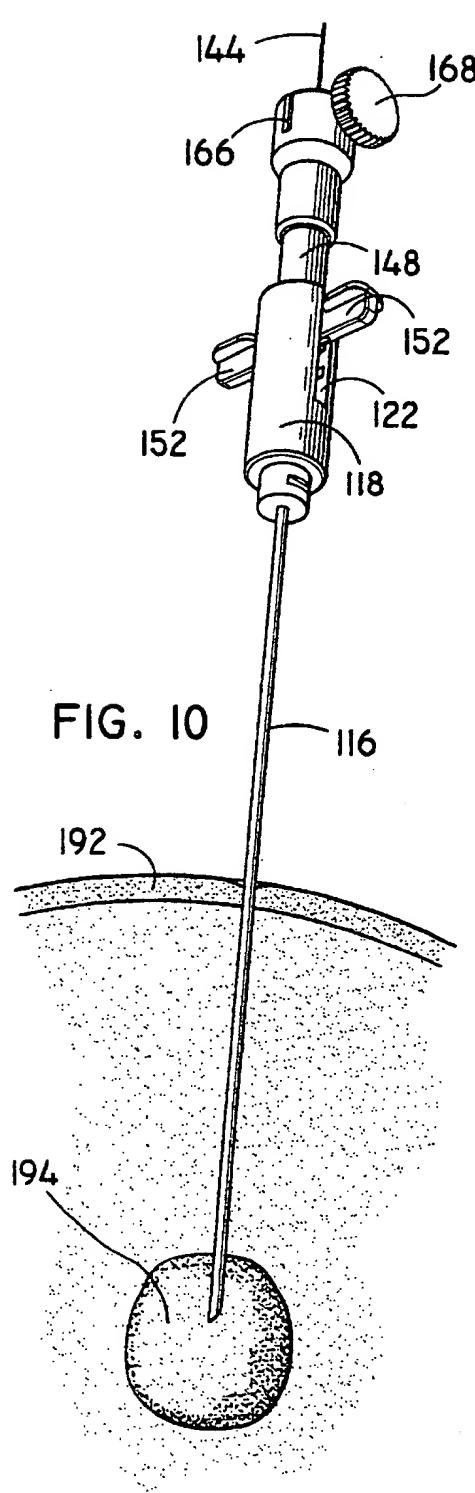
FIG. 1

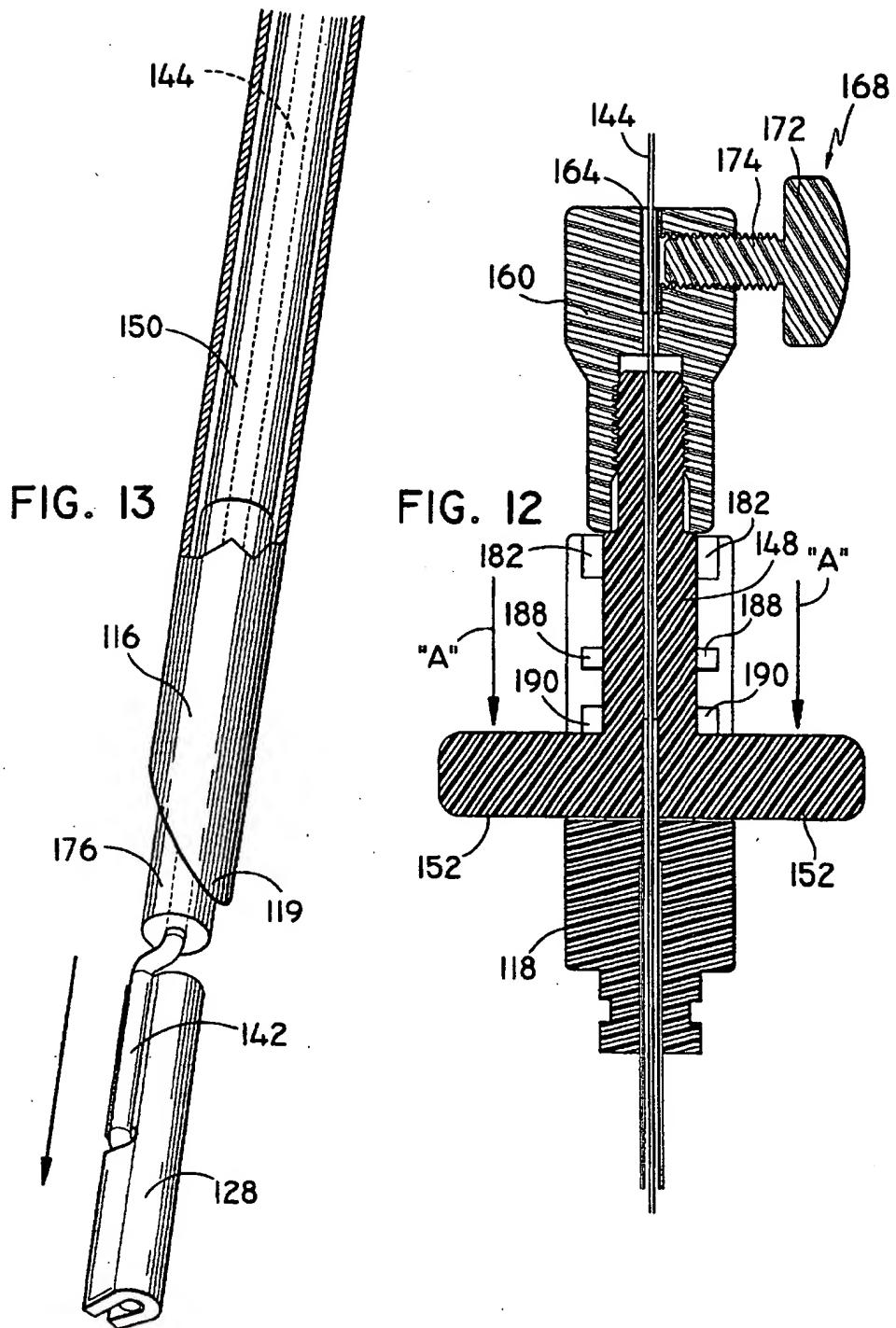




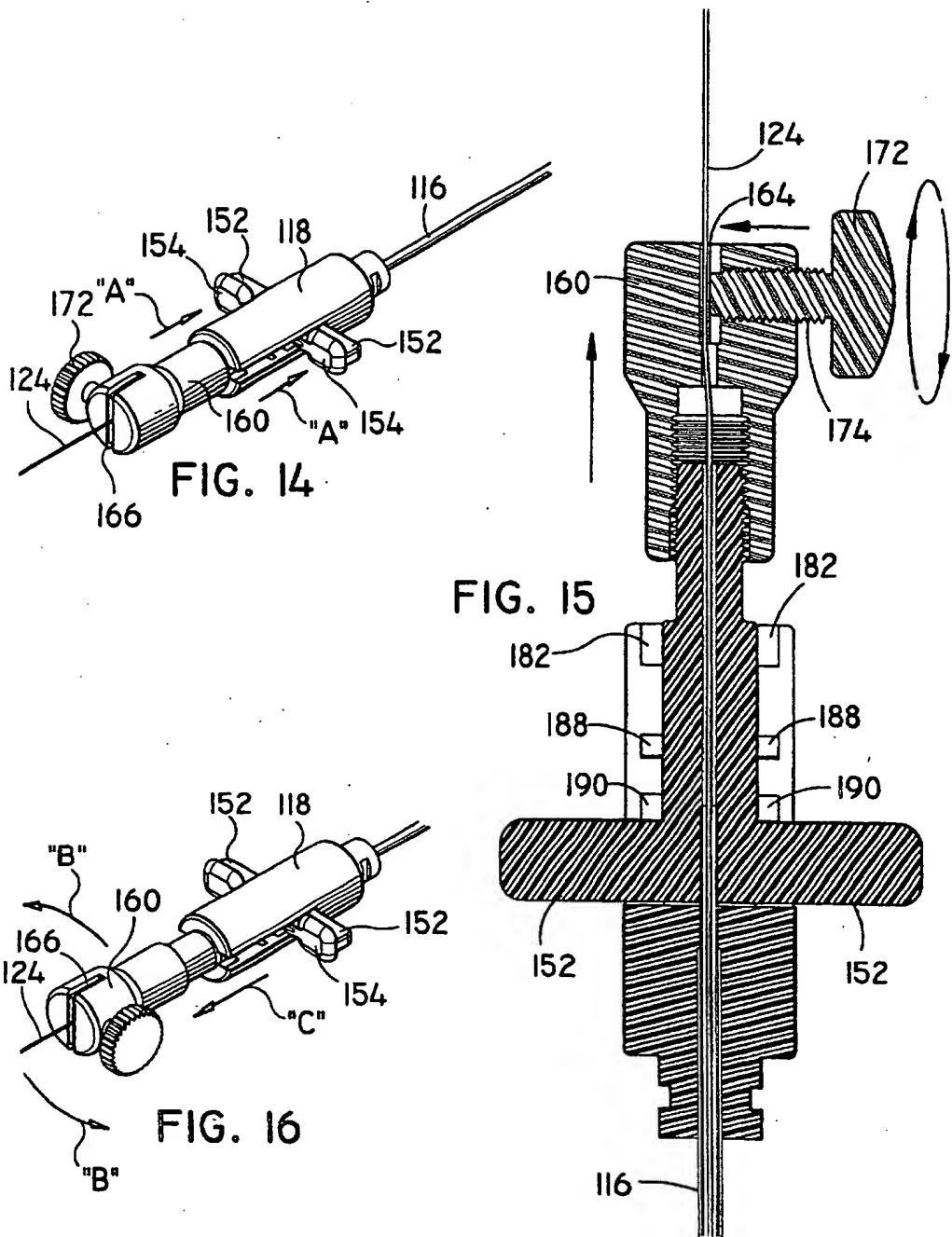
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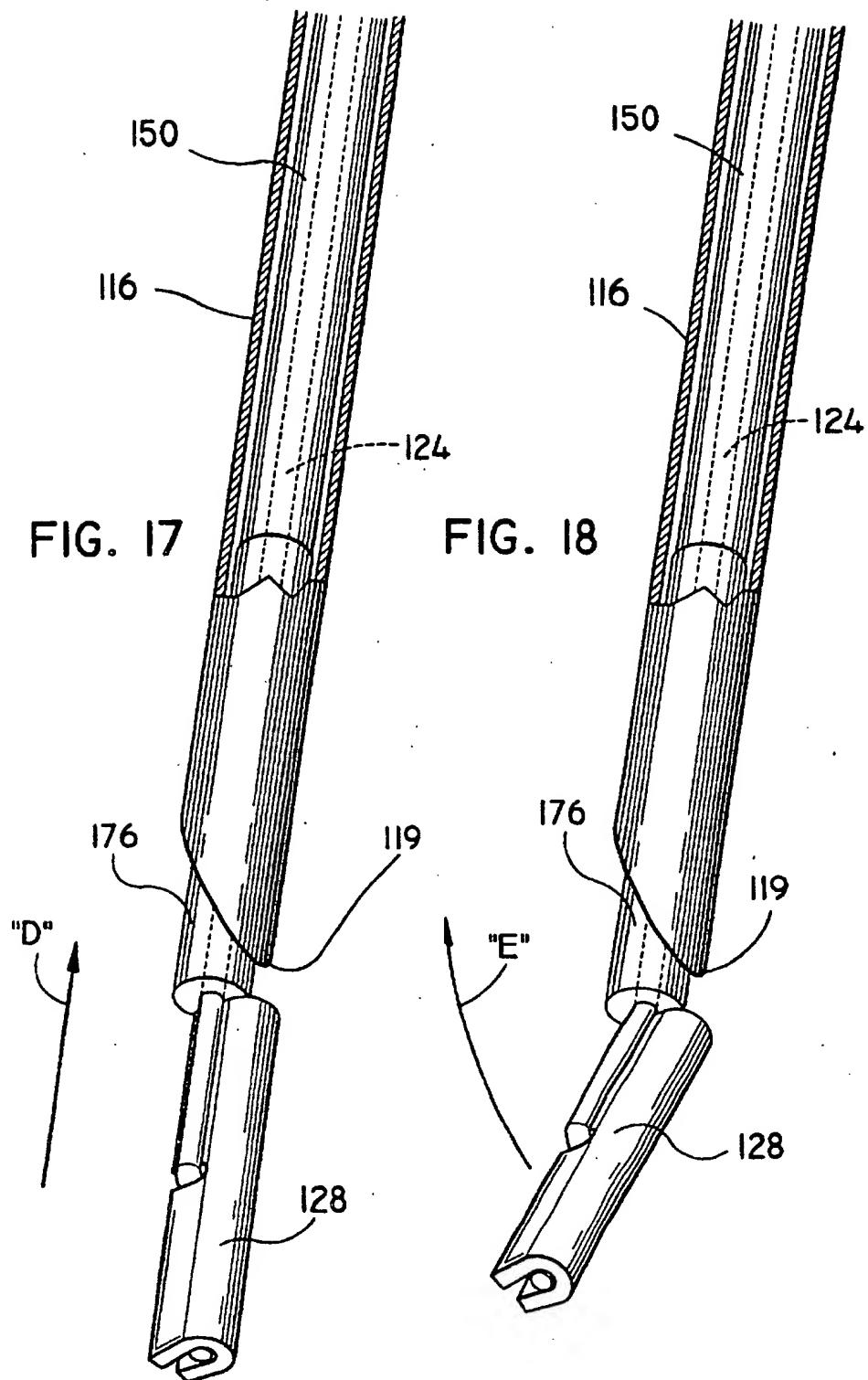




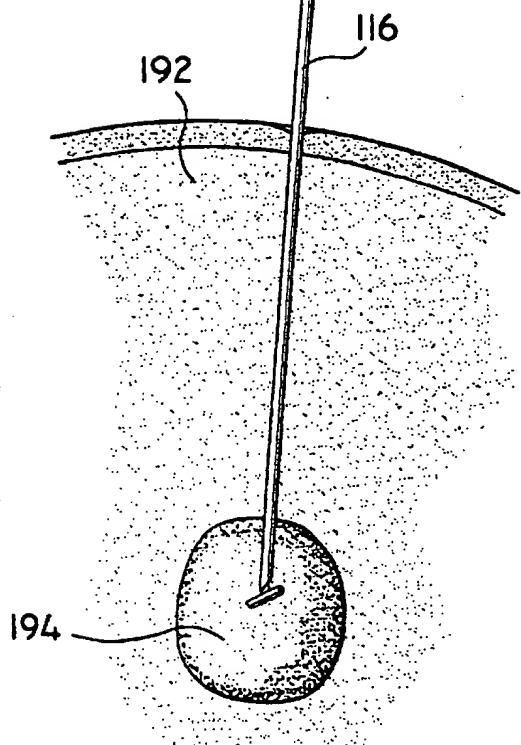
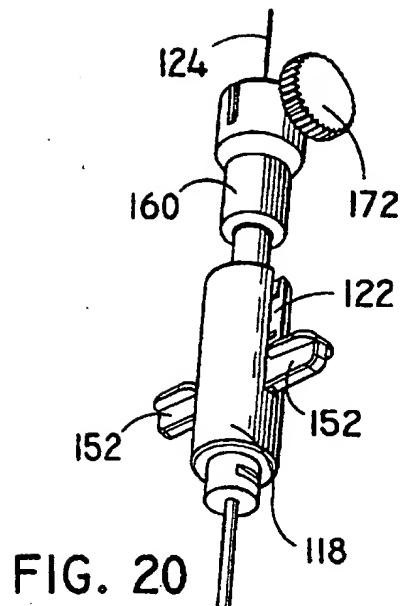
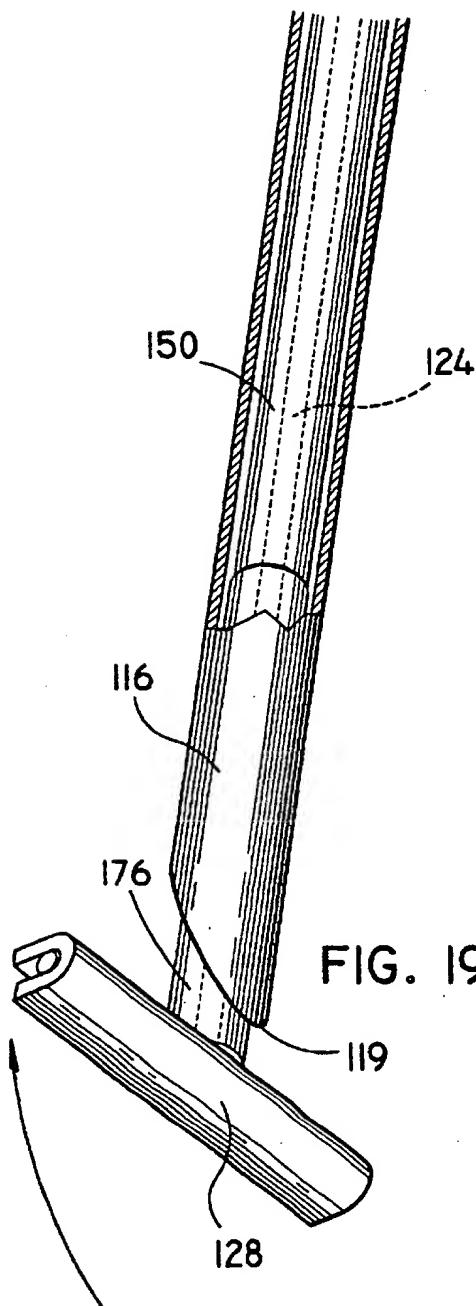
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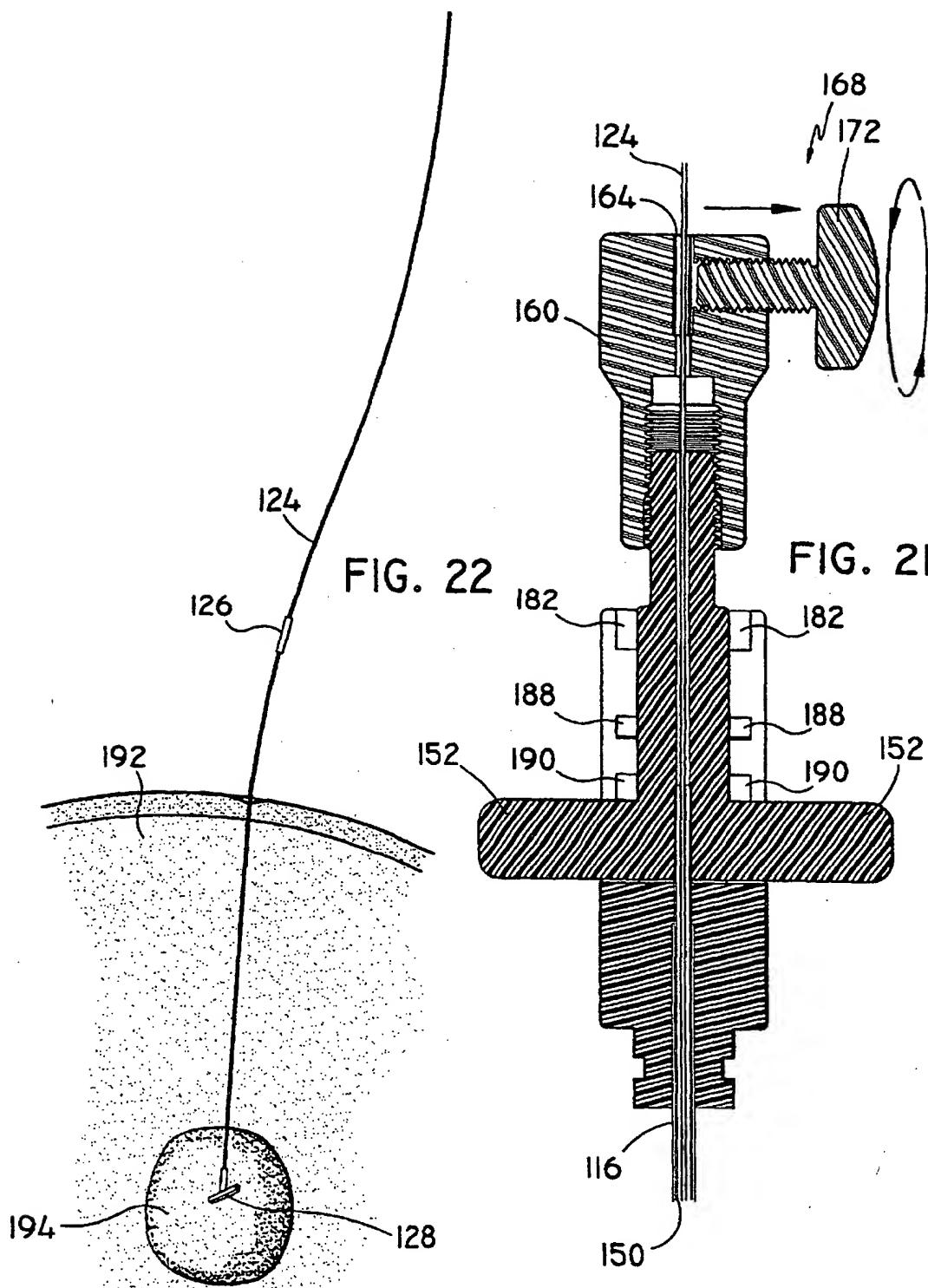


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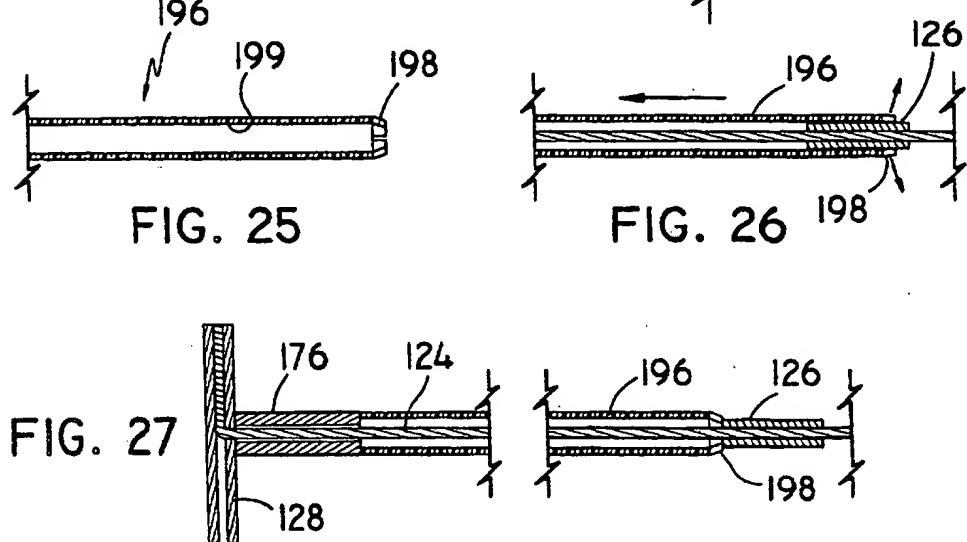
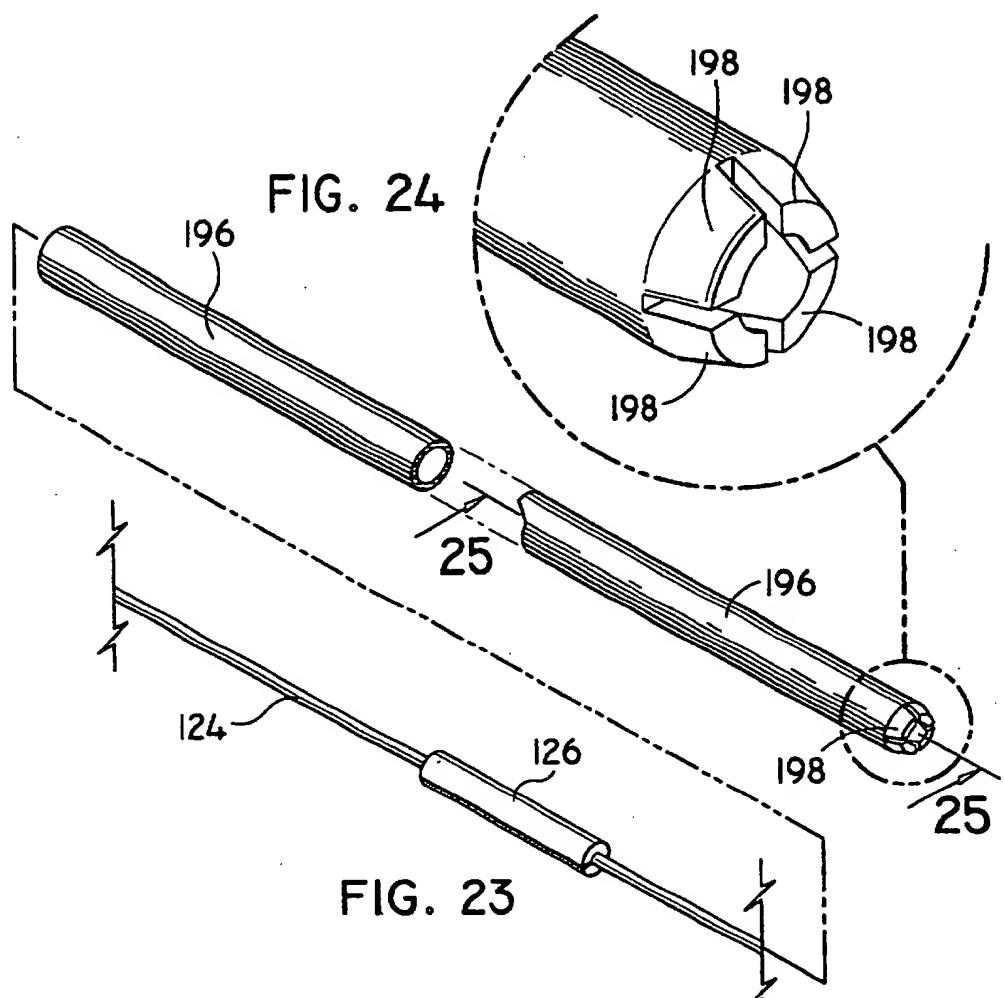


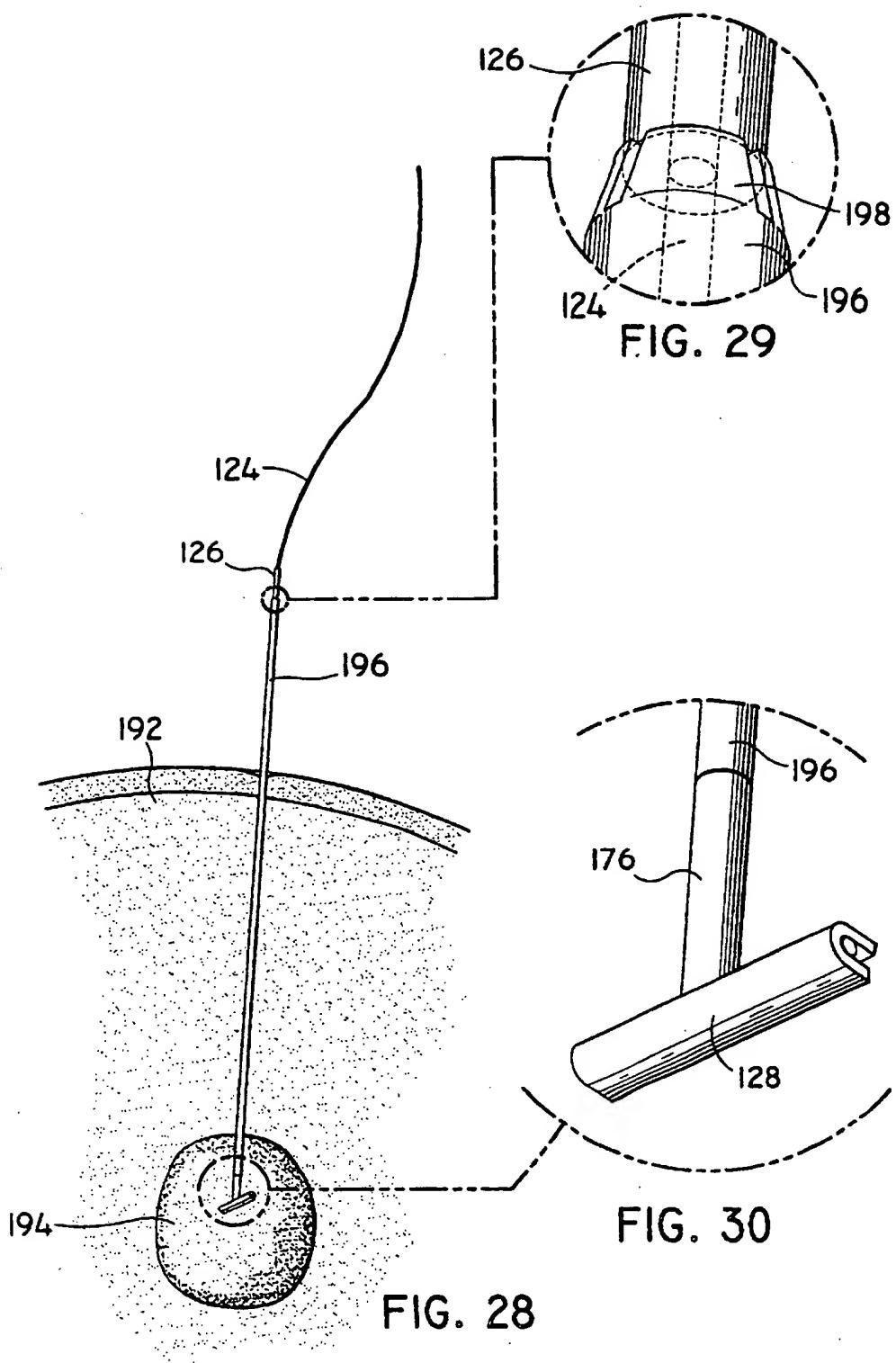
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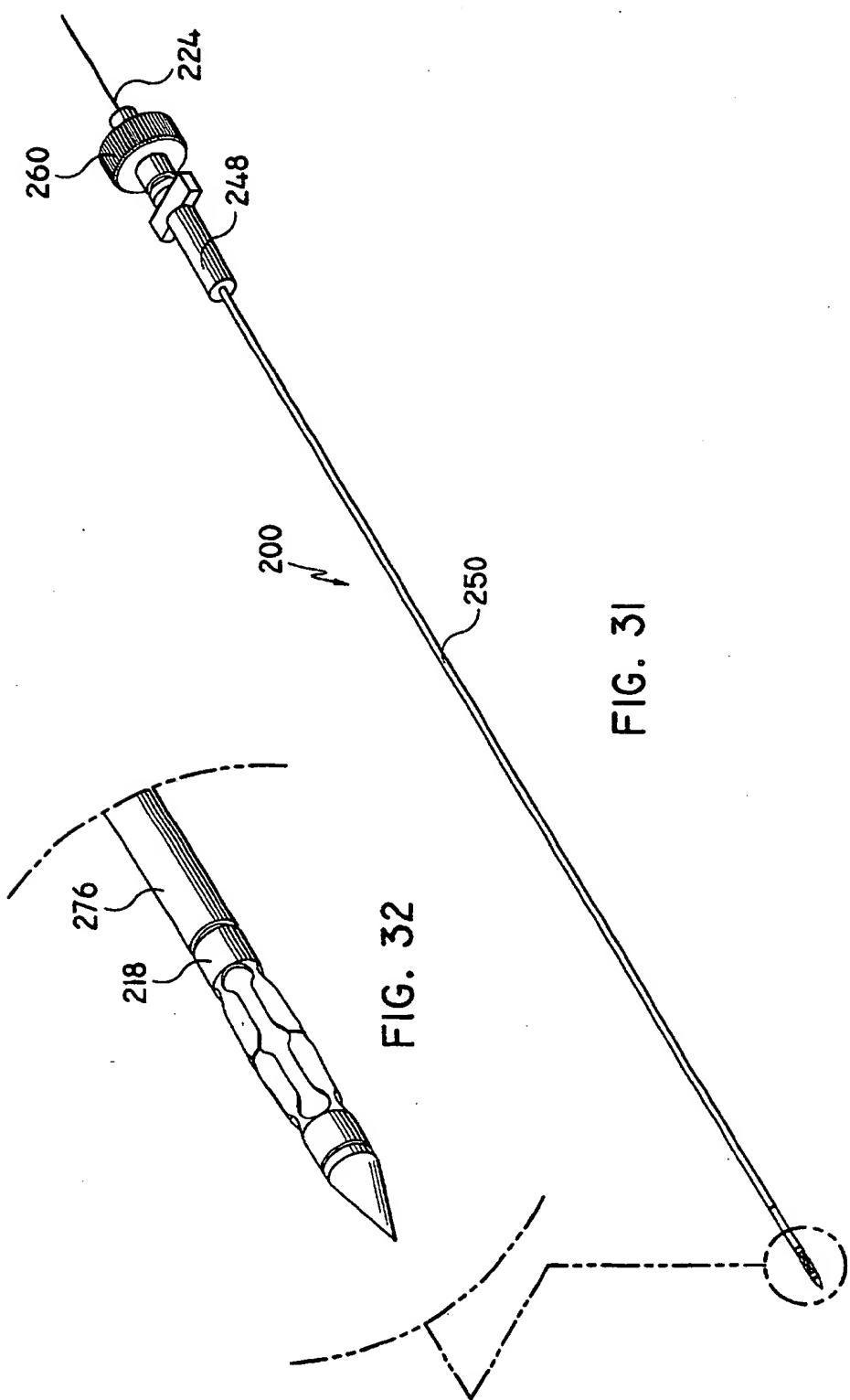


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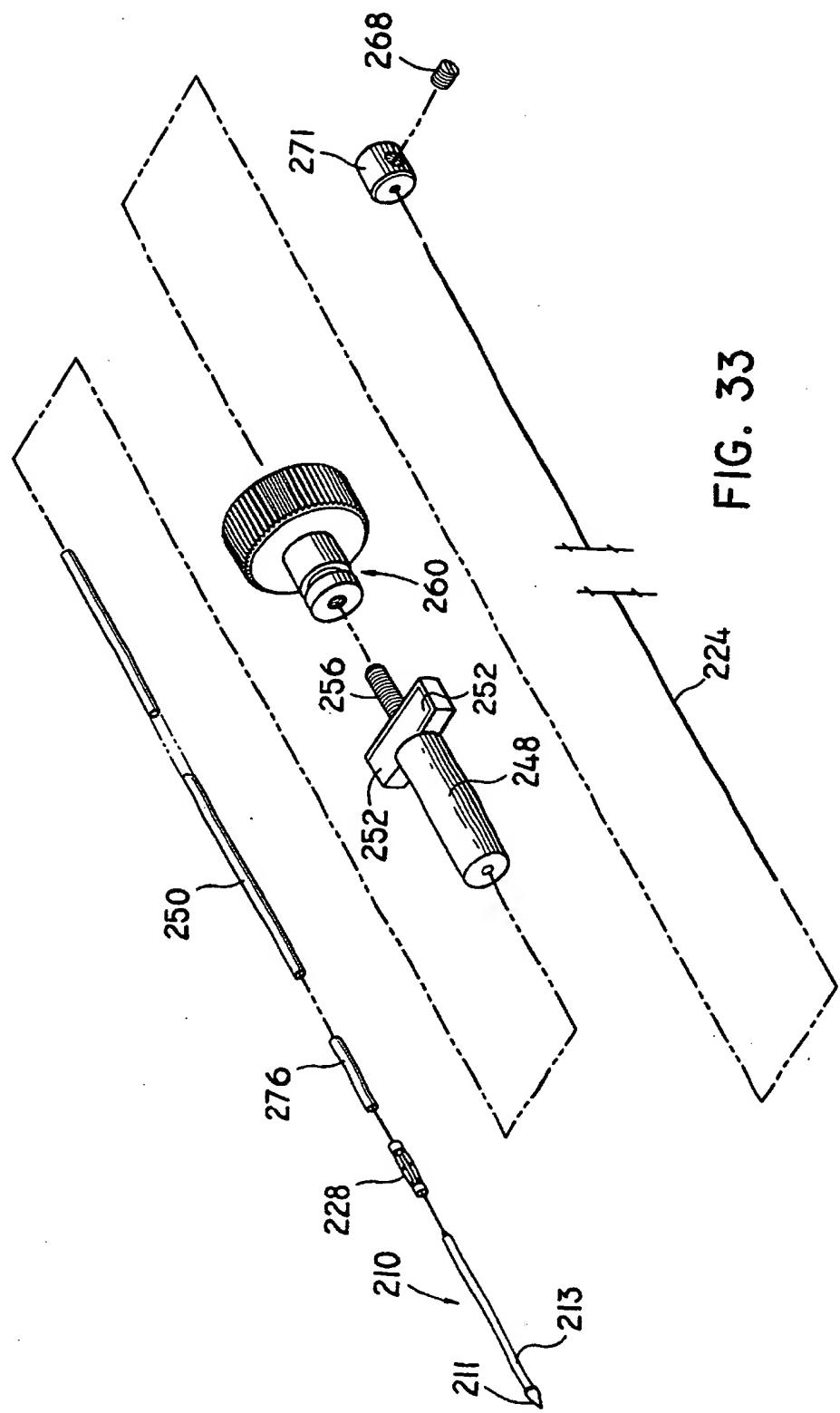


FIG. 33

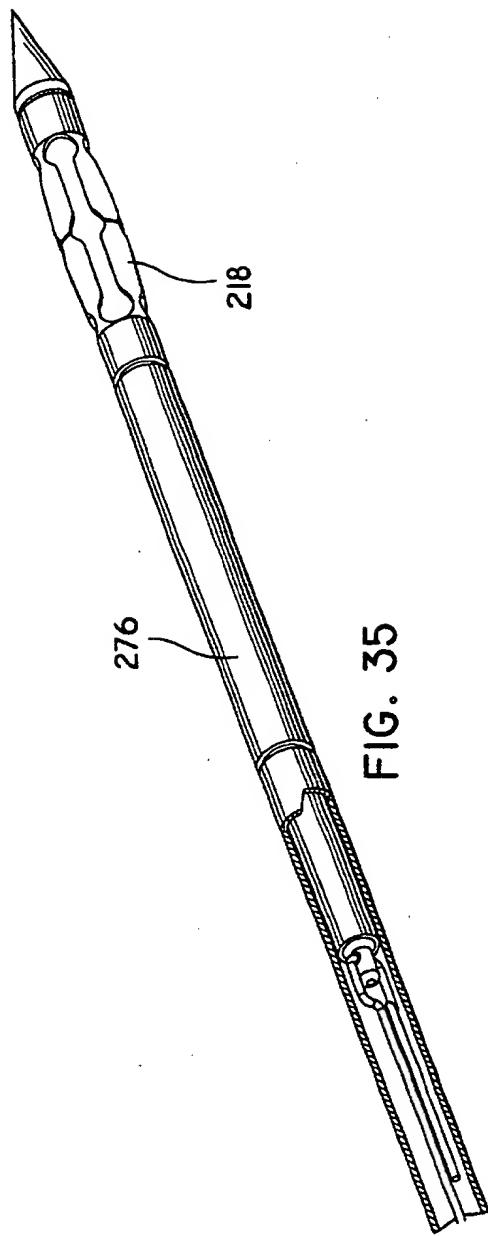


FIG. 35

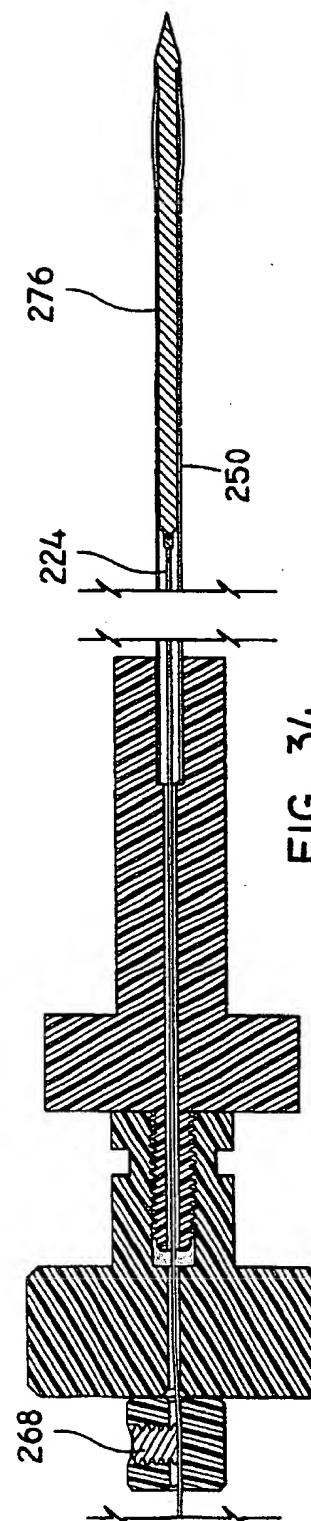


FIG. 34

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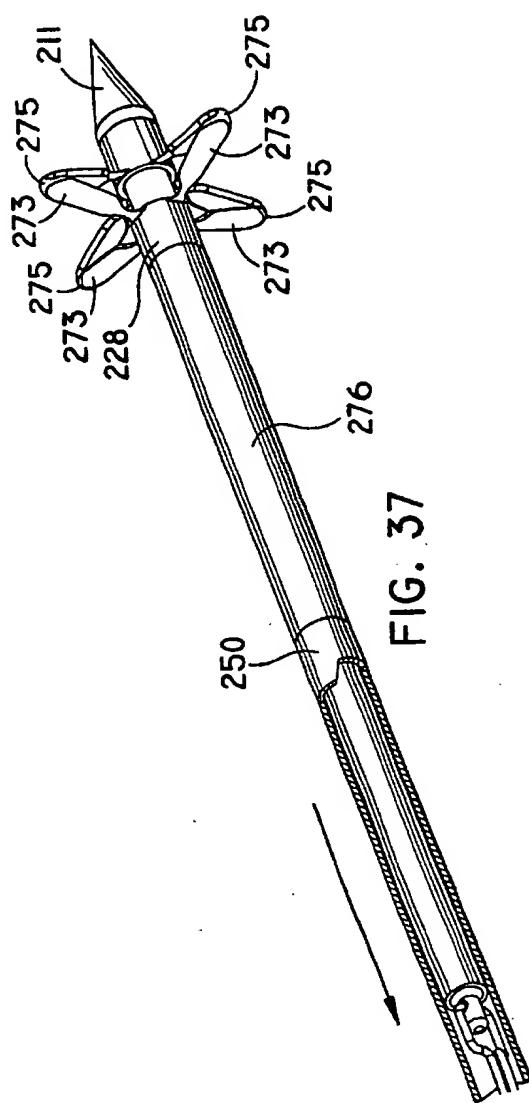


FIG. 37

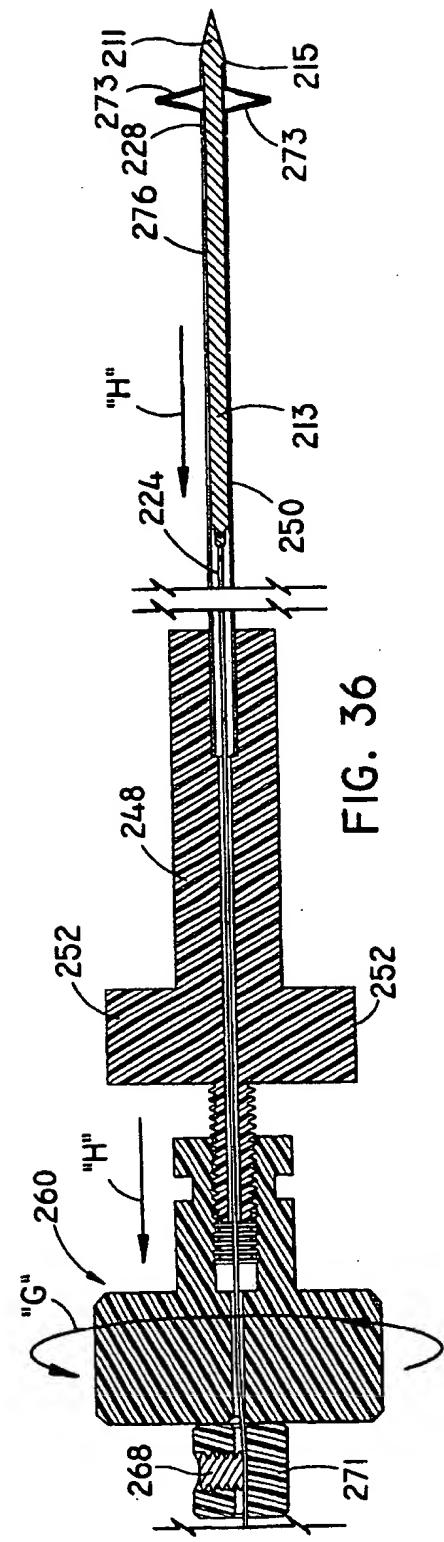


FIG. 36

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